The New Zealand
Journal of Agriculture.

VOL. 43. WELLINGTON, 20TH JULY, 1931. No. 1.

STRAIN INVESTIGATION OF GRASSES AND CLOVERS.

(Continued.)

E. BRUCE LEVY, Agrostologist, and STEPHEN H. SAXBY, Assistant in Agrostology, Plant Research Station, Palmerston North.

5. BROWN-TOP (Agrostis tenuis).

IN 1924 it was pointed out by the senior writer*, after three years study of the genus, that the common form of *Agrostis* in New Zealand was brown-top (*Agrostis tenuis*). Prior to this work it was held that true brown-top was confined to the North Auckland district, where the seed was harvested and sold under the name Waipu brown-top. In 1924 the export of brown-top was approximately 15 tons; in 1930 the export was 235 tons, largely from the South Island, valued at approximately £31,000, being the second highest in value in the list of seeds exported. This export supply is primarily for lawns and greens in Europe and America.

Regrassing work on secondary-growth country by the Department of Agriculture during the past seven years, mainly in Whangamomona County, Taranaki, clearly places brown-top foremost of any other single species for regrassing of secondary-growth hill country that has an annual rainfall of 40 in. or over. The sales of brown-top for hill country have very greatly increased, and the reasonably low price now ruling makes brown-top the cheapest seed for secondary-burn regrassing-work. Prior to 1924 brown-top ranged about 3s. per pound, and the average sample then contained well over 50 per cent. impurities and husk. From a lawn point of view these impurities were serious. The purity of the present-day sample of New Zealand brown-top is beyond reproach; the germination is high, and the price per pound about half what it was in 1924.

For lawns and playing-greens New Zealand brown-top is the grass *par excellence*, producing as it does a very fine and even turf, and being sufficiently hardy to stand the severe conditions of wear and close cutting

* "The Agrostis Species—Red-top, Brown-top, and Creeping-bent." *N.Z. Jour. of Agric.*, February, 1924, page 73.

that greens are subject to. Overseas, New Zealand brown-top is undoubtedly giving every satisfaction for all manner of playing-greens, and, in general, with the exception of the Canterbury dry-land type, is excellently suited for hill country sowings in New Zealand itself. None the less in order to maintain our export trade, and to keep pace with and withstand overseas competition in fine lawn-seed, it is worth while critically examining our type and by strain selection doing all we can to improve the good name of New Zealand brown-top overseas.

Stapledon*, dealing with the question of species and strain and seed mixtures for lawns, and enunciating the general principle of "one lawn one growth-form," claims as conforming to this principle a simple mixture of two species—brown-top and Chewings fescue. Quoting Mr. Dawson's experiments in connection with green-keeping research at St. Ives, England, he says, "Most striking, for example, are the plots of New Zealand bent (brown-top) and New Zealand Chewings fescue . . . And it would seem not at all unlikely that in these two grasses we have ready to hand—for the seed of both is harvested on a commercial scale in New Zealand—two forms which to a marked degree conform to the tentative principle which I have enunciated, and which may be expected to blend in an admirable manner if sown together as the sole ingredients in a seeds mixture."

We have long held the value of brown-top for lawns†—alone as a pure sward, or in association with Chewings fescue. As far as growth-form is concerned these two grasses are almost identical, both spreading by short underground tillers (sobils) that later develop multitillered crowns, which blended together make the ideal turf. Our claim has rather been that brown-top and Chewings fescue ecologically are not the same, and that a green if sown to a mixture of these two species tends according to conditions to run to the one or the other. Brown-top will, for example, stand much closer cutting than Chewings fescue. It will oust Chewings fescue on the damper and more fertile greens, but will take second place on dry greens that are not mown too closely. Between these two extremes, of course, there are intermediate habitats where the balance of power, as it were, favours the brown-top equally with the Chewings fescue, and a perfect blending of the two species results. The claim we make is that the greatest perfection in greens will be secured when it is known how to produce and maintain the ideal brown-top habitat. In the meantime, however, while there exist variable habitats on the lawn or green a mixture of brown-top and Chewings fescue is as near ideal as can be secured for the moment.

Other species of the genus *Agrostis*, to which genus brown-top belongs, are recommended by some workers and are used for greens and lawns. Red-top (*Agrostis palustris*) has been imported into New Zealand from America for years under the name red-top or fiorin. Red-top is an extremely bad lawn-grass, and not a pound of it should be brought into the country. It will not sward-in in a lawn, nor will it persist for long under the normal rolling and cutting to which lawns are subject; also it is quite useless as a species for hill country in New Zealand.

* "The Compounding of Seeds Mixtures and the Purchase of Seeds." *Jour. Board of Green Keeping Research*, March, 1931.

† "The Agrostis Species—Red-top, Brown-top, and Creeping-bent" *N.Z. Jour. of Agric.*, February, 1924, page 86; *Farm Economy*, June, 1928, page 11.

It is essentially at home and thrives best on wet peaty soils where loose unconsolidated conditions rule.

Another species that has become popular for greens in the United States is creeping-bent (*Agrostis stolonifera*). This grass is catalogued under several trade names, such as Cocoos bent and New Brunswick bent, and under the botanical name *Agrostis maritima*. Creeping-bent is entirely an overground creeper, and in order to make of it a good lawn grass copious watering and top-dressing of soil need to be applied to simulate the underground root-stock of brown-top or Chewings fescue. The natural habitat of creeping-bent is in wet, undrained, waterlogged soils, and it is particularly prevalent and often dominant in areas subject to periodical flooding. Sowings of creeping-bent have been made on hill country with an annual rainfall of over 60 in. per annum, and the

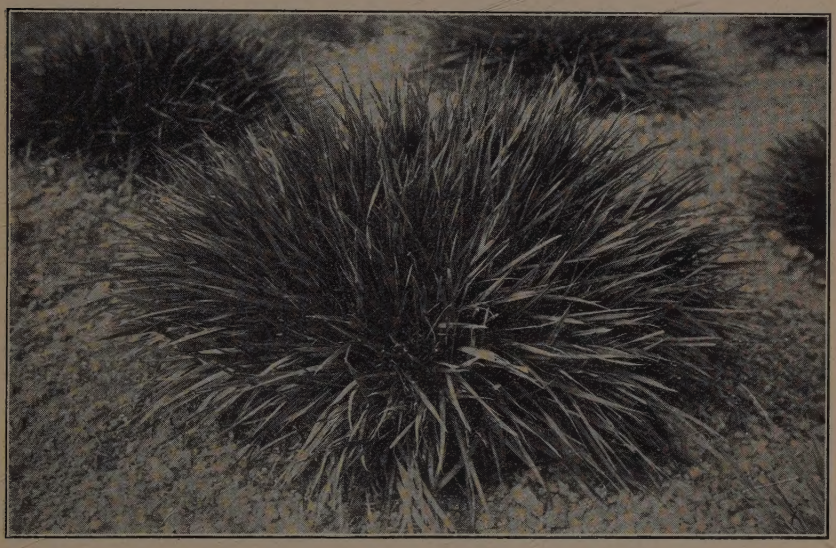


FIG. 1. SINGLE PLANT OF GENUINE BROWN-TOP (AGROSTIS TENUIS).

Showing dense multitillered crown as a result of frequent tillering from underground root-stock Leaves erect, blades flat, and of good grass-green colour.

[*Photo by E. Bruce Levy.*

conditions there were too dry for this grass to thrive. The normal playing-green is usually well-drained or should be well-drained for pleasurable play, and large playing-area such as golf-courses for the most part are on rising or undulating ground, dry rather than wet.

Richardson, working on the *Agrostis* species of the boglands of Ireland some years ago, describes *Agrostis stolonifera* as the common form there, and he gave this grass the name fiorin. Fiorin, however, as stated before, came to be applied to American red-top by the seed trade. This work of Richardson, however, but serves to confirm our diagnosis of the habitat conditions that must rule for creeping-bent to thrive well, and in New Zealand virtually the only place where it is harvested for seed is on an area in Canterbury inundated with water for the greater part of the winter. Such conditions can hardly

FIG. 2. SINGLE PLANT OF DRY-LAND BROWN-TOP (AGROSTIS SP. INDEF.).

Showing dense fine-leaved multitillered form that should prove excellent for greens on dry habitats alone or in conjunction with Chewings fescue. The colour of this plant is greyish-green rather than grass green.

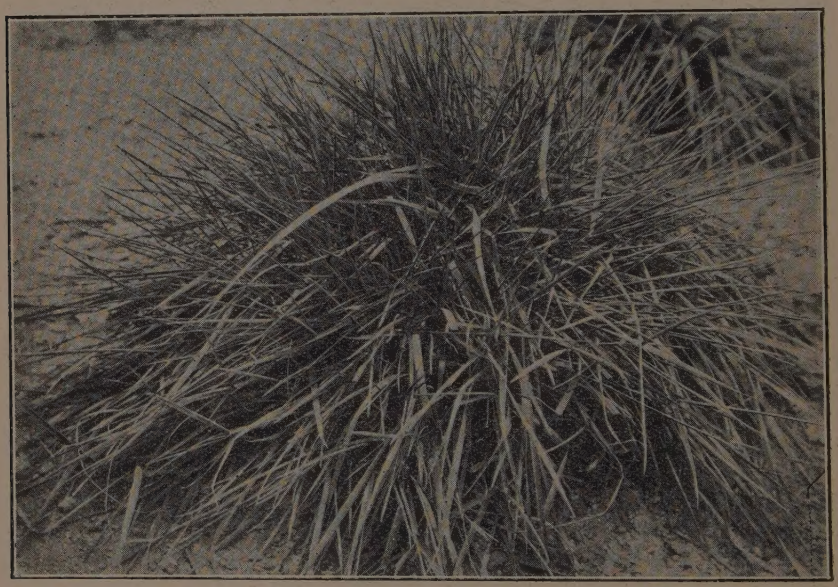


FIG. 3. SINGLE PLANT OF DRY-LAND BROWN-TOP SHOWING SOMEWHAT COARSER FOLIAGE THAN THAT IN FIG. 2, AND TENDENCY OF MANY LEAVES TO ROLL.

The roll-in-leaf tendency of this form may be a result of the drier and more xerophytic habitat to which the type is attuned. The colour of this plant is a distinct steely grey green.

[*Photos by E. Bruce Levy.*

be called ideal for playing-greens. Creeping-bent on wet lawns about the home forms a moderately good green in association with Poa trivialis, but such lawns would probably not stand up to play or treading during the winter months. As before stated, repeated applications of soil are necessary to make of creeping-bent a fine lawn-grass. About the home garden creeping-bent is bad in a lawn, as it spreads rapidly by stolons or cuttings to the flower borders or beds during the winter when cultural operations are difficult. A further objection to creeping-bent in a green is its marked tendency to zonation and segregation into definite patches, often presenting quite a different eye-appearance. Stapledon claims that zonation giving rise to different colour effects on the green inclines to put the player off his shot or affords at least a sufficient excuse for a bad shot.

Velvet bent (*Agrostis canina*) is also regarded in America as a fine lawn-grass. We have only one sample of *Agrostis canina* from America under trial at the Plant Research Station, and this consists of 25 per cent. of brown-top and 75 per cent. of creeping-bent. South German mixed bent is a trade name applied to *Agrostis tenuis* (brown-top) seed from Southern Europe, and it also is popular in America because it is held to contain regularly 1 to 2 per cent. of creeping-bent and some velvet bent. The only sample of this under our trial is 100 per cent. brown-top.

Rhode Island bent and Prince Edward Island bent are also two American trade names applied to *Agrostis tenuis*. A good deal of brown-top also is harvested in Canada, and is sold under a certification scheme that guarantees trueness to type. A small amount of brown-top is also harvested in Great Britain, botanists there for the most part still adhering to the name *Agrostis vulgaris*.

Strain Work in New Zealand on Brown-top.

The outstanding result of our strain work to date on brown-top is the identification of two distinct types, ecologically and botanically. One type occupies the normal rather wettish, stiff, sour clays of both North and South Islands, and is the dark-green, broader, flat-leaved form, with short underground tillering root-stock; the other occupies what may be termed run-out arable light wheat country, such as is found, for example, in the Kirwee, Aylesbury, Dromore, and Chertsey districts of Canterbury. This form is somewhat finer in the leaf, with leaf often distinctly rolled rather than flat, and of a grey-green colour. The root-stock is strongly rhizomatous (having underground creeping stems) rather than sobiliferous (having short underground tillers) like the typical brown-top. The seed-head is compacter and coarser and the ligule is longer than in typical brown-top.*

Ecologically, this dry-land Canterbury brown-top fits in more essentially with a habitat suitable to Chewings fescue, and the form at once appeals as of great promise in association with Chewings fescue on greens that are too dry for the normal brown-top type to thrive in. It is probably not quite so good a colour as the genuine

* Dr. H. H. Allan is at present studying this dry-land brown-top type, and a paper on the systematics of the form is in course of preparation.

FIG. 4. SINGLE PLANT OF AMERICAN RED-TOP (AGROSTIS PALUSTRIS).

Showing coarse nature of the plant, with tendency to spread and form a loose open sward incompatible with the making of a good green. Red-top does not stand close cutting and, all features considered, it would be difficult to name a grass of less value for lawns.

FIG. 5. SINGLE PLANT OF CREEPING-BENT (AGROSTIS STOLONIFERA).

Showing paucity of growth and spread of overground runners (stolons). By covering these runners with soil top-dressing and by copious watering it is possible to make a green of this grass. Creeping-bent is useless for dry greens, the natural habitat of the grass being low-lying, water-logged soils that are frequently inundated with water in the winter.

[*Photos by Stephen H. Saxby.*

FIG. 6. PORTION OF SINGLE-PLANT TRIAL AREA, SHOWING THE THREE TYPES OF AGROSTIS FOUND IN NEW ZEALAND.

Taking the two nearest plants in each of the three complete rows in the photo, N.Z. red-top is seen on left, genuine brown-top in middle, and dry-land brown-top on right. The N.Z. red-top showing is not so coarse and is more spreading than American or German red-top.

[*Photo by E. Bruce Levy.*

FIG. 7. SINGLE PLANTS FROM LINE LABELLED AGROSTIS CANINA RECEIVED FROM AMERICA.

Of the sixteen plants showing in the two middle rows, four are ordinary brown-top and twelve are creeping-bent. According to principles in lawn-making stated by Stapledon, two dissimilar forms such as these are not advisable in the same lawn.

[*Photo by Stephen H. Saxby*

brown-top, being greyish-green rather than the normal grass-green. On the other hand, it is a better winter grower and has a much stronger root-stock, and apparently can keep alive and thrive moderately well on drier and more impoverished soils than can the true brown-top. It has been studied under lawn conditions for two years, and swards just as well as ordinary brown-top, either as a pure sowing or in mixtures with true brown-top and Chewings fescue. It has, however, given disappointing results on hill country, and must be classed as inferior to the ordinary brown-top for regrassing work on such country.

In the wetter areas of certain districts, generally in association with creeping-bent, is a third type of *Agrostis* resembling red-top more closely than brown-top. This form of red-top, however, is quite distinct from the normal red-top imported from America or Germany. This form of red-top is also under critical study by Dr. Allan, but economically it may be ignored, excepting as a bad weed, for it is not a form suitable for fine lawns nor would it be suitable for hill country. This form would not enter our present certification scheme as applied to brown-top, yet several samples of the type have been harvested and placed on the market. This but emphasizes the need of buying within the guarantee given by certification.

Five hundred and two lines of commercial New Zealand brown-top have been sown and tested in our trial grounds at Palmerston North during the last two years, and the following table, compiled from an analysis of 296 lines of known district of origin, gives accurate information regarding the brown-top type and location of crops harvested in New Zealand:—

District of Origin.	Total Number of Lines.	True Brown-top.	Dry-land Brown-top.	New Zealand Red-top.	Creeping-bent.
Southland	130	126	3	1	..
Otago	55	55	..	..	..
Canterbury (foothills)	73	70	3	..	..
Canterbury (dry plains)	30	2	28	..	..
Canterbury (low-lying, wet)	1	..	..	..	1
Waipu	7	6	1*	..	..

* One sample mixed lot.

Single-plant Study.

Approximately 1,000 plants, representing some fifty lines, were put out 2 ft. apart each way as single plants. These included true brown-top, dry-land brown-top, American and German red-top, South German mixed bent, Cocoos bent, New Zealand red-top, and New Zealand creeping-bent.

It would perhaps be hard to imagine a more varied lot of single plants, but all may be classified into five dominant groups: (1) True brown-top (Figs. 1 and 8); (2) dry-land brown-top (Figs. 2, 3, and 9); (3) New Zealand red-top (Fig. 6); (4) American red-top (Figs. 4 and 10); and (5) creeping-bent (Fig. 5).

FIG. 8. SINGLE PLANTS OF GENUINE BROWN-TOP, SHOWING SOME VARIATION IN GROWTH-FORM BUT SIMILARITY OF TYPE THROUGHOUT.

FIG. 9. SINGLE PLANTS OF DRY-LAND BROWN-TOP, DEPICTING SOME VARIATION IN GROWTH-FORM, BUT IN GENERAL FINE-LEAVED DENSE GROWTH THROUGHOUT. [*Photos by Stephen H. Saxby.*

Among the true brown-top and the dry-land brown-top there are some extremely promising forms, both in regard to their value as fodder and for greens or lawns. The splitting-up of these and testing for the two major purposes in view, however, is work for the future. New Zealand needs a really good brown-top for hill country

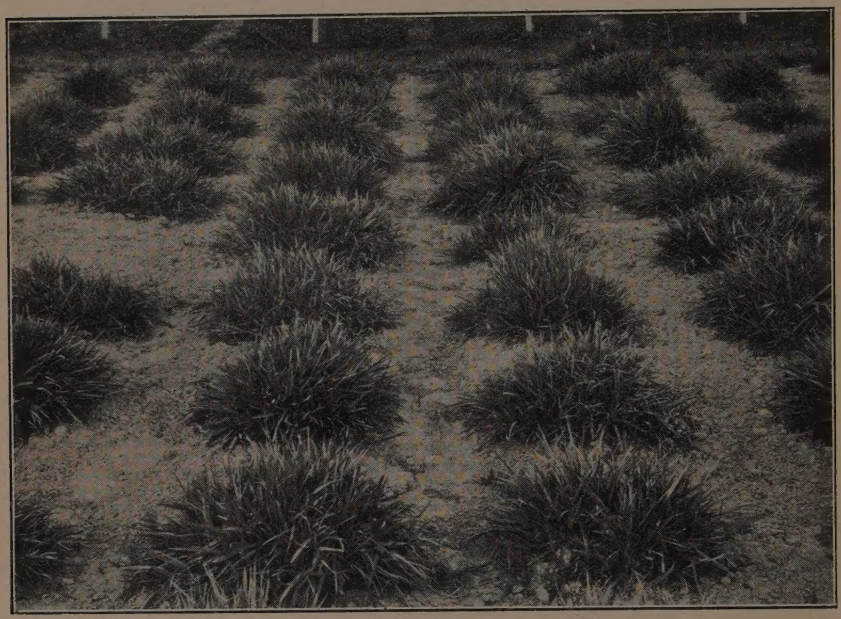


FIG. 10. SINGLE PLANTS OF AMERICAN RED-TOP, SHOWING COARSER NATURE OF FOLIAGE.

There is a definite tendency for these plants to spread widely and open up in the centre.

[*Photo by Stephen H. Saxby.*

regrassing, and sport offers lucrative payments to the country that will cater best to its requirement. Already exports from New Zealand of fine lawn-seeds run into approximately £100,000 per annum, and this may be regarded as ample justification for carrying on improvement work, so as to build up a reputation and ensure that nothing but the correct type and the best type goes to fill overseas orders.

Arsenic Pentoxide absorbs Atmospheric Moisture.—In connection with the use of arsenic pentoxide for weed-control, as described in last month's *Journal* article, "Weeds in Lawns and Greens," it should be noted that this material absorbs moisture when exposed to the air, and should therefore be kept in an airtight tin or other receptacle when not in use. This is important to dealers and users holding fairly large quantities, also from the viewpoint of getting the correct strength when making up a solution.—*E. Bruce Levy.*

FEEDING OF IRON IN BUSH SICKNESS.

SOME FURTHER RESULTS AND DIRECTIONS.

B. C. ASTON, Chief Chemist, Department of Agriculture.

THE article on the feeding of iron in bush sickness, published in this *Journal* for June, has aroused such interest in the method of automatic treatment advocated that some further notes seem desirable to supplement the account given last month.

Arrangements have now been completed whereby a limited amount of native finely ground carbonate of iron, called by mineralogists spathic iron ore, shall be available to farmers at cost price, which is 8s. per cwt., f.o.r. at Auckland, the freight being payable by the farmers on delivery or "freight forward." Already 1½ tons have been distributed under these new conditions. It is considered that the matter has now passed beyond the experimental stage, and therefore no further free distribution will be made of this compound. Application should be made for supplies to the Chief Chemist, Department of Agriculture, P.O. Box 40, Wellington. For those who desire to add bonedust and iodine as well as salt to the iron lick the instructions given at the end of this article will apply.

The important thing to be realized is that this iron is given as a food and not as a medicine. By this means the animal supplements the deficient amount of iron in the natural foods; therefore the iron must be given systematically in the same way as any other food. Remembering that the iron is given as a food, the whole treatment of the iron-hungry animals on the pastures of the pumice lands becomes a reasonable continuous process in the mind of the farmer, who is able to see that one or two doses will not cure a sick animal any more than one or two meals will keep a man from starving a day or so later. It is necessary to stress this point, as some purchasers of the iron compounds sold by the Department seem to expect that a cure once effected should be permanent.

The cost of the iron is so low per head of stock that no farmer on any area that is even slightly affected with bush sickness can afford to neglect this *preventive* treatment. If at any time a *curative* treatment becomes necessary for individual animals, systematic drenching with citrate-of-iron (2 oz. of a 6-per-cent. solution) will effect a speedy cure. The automatic method of administering this food iron to ruminant stock by licks can be supplemented by feeding hay and ensilage which have been treated with the iron carbonate and salt. The pellet method is more expensive, but the amount it is economical to feed has not been determined. If meat-meal feeding, at 1s. 3d. per sheep for three months, proves as effective as the pellet method with larger quantities and longer feeding using vegetable meal, further progress in supplementary winter feeding may be made on the bush-sick lands.

Striking confirmation of the writer's conviction that it is quite possible to farm Mamaku country with either sheep or cattle has been received from a farmer in a large way on the Mamaku Plateau. He writes:—

"We are handling a large number of cattle and sheep at our bush block, and also at Mamaku. About twenty trucks of fat stock have been loaded out this year.

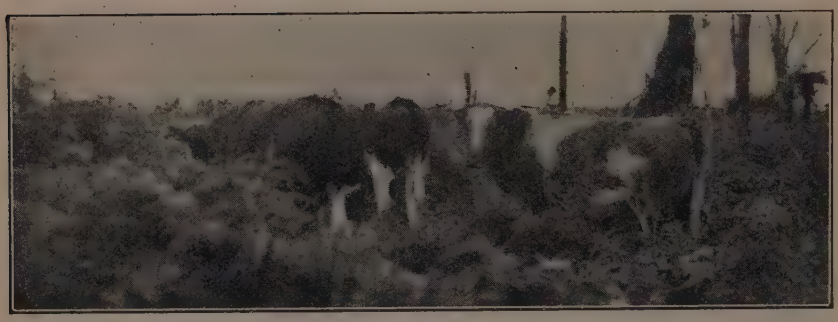


FIG. 1. FAT BULLOCKS ON THE MAMAKU PLATEAU

FIG. 2. OTHER HEALTHY CATTLE.

FIG. 3. THRIVING SHEEP.

All three photos were taken recently on the Mamaku Plateau farm referred to in the article, where cattle and sheep are kept healthy by the iron-carbonate treatment.

We have had 350 ewes in lamb at Mamaku since February. All the rams will have been here two years, with the exception of a change of two months. The stock have done remarkably well here. The land has been top-dressed. An iron and iodine lick has been used—molasses, bran, iodine, sulphate, and carbonate of iron. We always put some in our haystacks. We are quite confident that your Department's work is going to have great results in this district. We have had 250 head of cattle and 1,000 sheep on our bush farm. Our fat stock have realized good prices at Westfield, the sheep in some cases topping the market. The ewes at Mamaku chase the attendant when he puts out the chaff and lick in small heaps (with a little aniseed oil) on the ground. The cattle are the same."

This is one of the most satisfactory letters the writer has received, and indicates, taken with other information, that the bush-sickness bogy need no longer be feared in any scheme for settling country reported to be the very worst for sickness.

A well-known farmer at Pikowai, Matata, thinks that carbonate of iron is most useful in combating bush sickness when given in the form of a lick, and that cattle take it quite readily. Milking cows that have access to it at all times have during all the dry weather kept remarkably fit. Although top-dressing is a valuable aid, however much was done he would always give every beast the chance to take the lick.

Use of Iron Carbonate in Calf-feeding.

Until an enterprising and successful settler in the Kaharoa district experimented with carbonate of iron in calf-rearing this compound had not previously been used for that purpose, the water-soluble citrate of iron and ammonia being alone used for mixing with the calves' feed milk. One teaspoonful of iron carbonate in a bucket of milk was the daily dose. Where great difficulty had been experienced before, two batches of calves were easily raised by this method, the final condition of the animals being excellent, and the farmer enthusiastically recommended the same treatment to his neighbours.

It may be said that although the carbonate of iron is insoluble in water, it is a finely ground flour, and there is no difficulty in keeping it suspended in the milk, so that the calves consume the whole of it. Calves treated this way, says the farmer, take to the lick straight away when weaned—in fact, "they let you know if you forget to put it out." He always keeps it in the cow-bails, has had no trouble about the cows coming in at the right time, and has not "changed" a beast on account of bush sickness since using the carbonate. This is his second season milking, although he has been in the district ten years.

A Mixed Lick, and Treatment of Ensilage and Hay.

When it is desired to feed a mixed lick containing bone-meal and iodine the following is recommended for bush-sick country: Add 2 oz. of potassium iodide dissolved in a little water to 1 cwt. of agricultural salt, sprinkling it on with a can. This is then mixed with equal parts each of native carbonate of iron and bone-meal (*i.e.*, one-third of each). A little molasses may be added with advantage, and if the animals show any reluctance to commence taking the lick a few drops of aniseed oil will be efficacious.

For treating ensilage 20 lb. of mixed salt and carbonate of iron (equal parts) should be spread in thin layers during the building of the stack, so as to cover 1 ton of ensilage. A similar method may be adopted with hay.

COMMERCIAL FERTILIZERS AND THEIR BASIS OF SALE.

(Continued.)

J. A. BRUCE, Inspector of Fertilizers, Department of Agriculture, Wellington.

II. PHOSPHATES SOLUBLE IN WATER.

Superphosphate.

SUPERPHOSPHATE is so well known as a fertilizer that it is hardly necessary to give more than a brief outline of its manufacture. It is the product of natural rock phosphate treated with sulphuric acid. Roughly speaking, 1 ton of finely ground rock phosphate is thoroughly mixed with about 1 ton of sulphuric acid to make 2 tons of superphosphate. The mixture while still in a hot and fluid condition is run into large receptacles called "dens," where it soon solidifies, after which it is removed, crushed, dried, and left to mature. The resulting mixture, containing the soluble phosphate of lime (monocalcium phosphate) and hydrated sulphate of lime (gypsum), is the superphosphate of commerce and agriculture. As somewhere about 2 tons of the mixture are obtained from 1 ton of phosphate rock, the superphosphate contains about half as much phosphoric acid per ton as the original rock.

Superphosphate is no longer imported for the New Zealand market, but is manufactured from high-grade rock brought from phosphate-yielding islands in the Pacific, notably Nauru, Ocean, and Makatea. The first superphosphate works was built at Burnside, near Dunedin, in 1882, and another at Westfield, near Auckland, in 1887. To-day eight large and efficient plants are operating, the combined output of which for the year 1929–30 exceeded 264,000 tons, valued at £1,400,000 (*Abstract of Statistics*, August, 1930). Of the amount produced, 203,868 tons alone were used for pasture top-dressing purposes during the year quoted, as shown in Table 1.

Table 1.—Superphosphate used for Pasture Top-dressing, 1929–30.

Areas.	Acreage top-dressed with Superphosphate.	Quantity (in Tons) of Superphosphate applied.
All New Zealand	1,761,958	203,868
North Island	1,453,556	176,903
South Island	308,402	26,965
Land Districts.		
North Auckland	178,068	24,693
Auckland	743,646	94,542
Taranaki	147,194	15,727
Wellington	232,112	25,801
Gisborne, Hawke's Bay, Marlborough, Westland, Canterbury, Otago, and Southland	460,938	43,104

The world consumption of superphosphate for the year 1928 was estimated at 14,834,000 tons (*English Fertilizers and Feeding Stuffs*

Journal, April, 1930), a fact which places superphosphate easily in the leading position in modern fertilizer production. The consumption of basic slag, which comes next, was estimated at 5,330,000 tons (*Agricultural Research in 1929*).

In addition to being a popular "straight" fertilizer, superphosphate is the principal component of a vast number of proprietary "mixtures" offered for sale in practically all agricultural countries throughout the world. Table 3 gives some idea of the popularity of superphosphate in the making of special fertilizer mixtures for various crops as offered for sale under a great variety of brands in New Zealand.

Solubility and Composition of Superphosphate.

The use of superphosphate as a fertilizer developed from the idea that it is necessary to change the insoluble form of phosphate in natural ground-rock phosphate into a soluble form so as to make it quickly available to plants, and, although there are several other chemical methods for preparing soluble phosphate compounds, the treatment of phosphate rock with sulphuric acid is the process which has come into general use and is to-day the basis of the modern fertilizer industry. It should be emphasized that tricalcium phosphate, the (hypothetical) compound of rock phosphates, is insoluble in water and, moreover, is only to a very small extent soluble in citric acid (standard solution), which is considered to be the nearest theoretical preparation comparing with the dilute acid solvents of the soil. As a result of recent tests in the United States, it is now claimed that pure tricalcium phosphate is approximately 75 per cent. as effective in the nutrition of plants as the phosphoric acid of ordinary superphosphate.

The value of superphosphate for selling purposes under our Fertilizers Act, 1927, is based on its percentage of phosphoric acid rendered soluble in water. In the case of all fertilizers it is essential for some accurate information regarding solubility or insolubility to be given, as it is impossible for the purchaser to judge of the exact nature of any fertilizer by its appearance, weight, smell, or taste.

Monocalcium phosphate the fertilizing compound of superphosphate, is readily soluble in water, and in itself contains about 60·7 per cent. of plant-food as phosphoric acid. The high-grade superphosphate distributed in this country has about 34 per cent. of monocalcium phosphate, equivalent to approximately 20·6 per cent. of phosphoric acid. Hydrated sulphate of lime, the other principal constituent of superphosphate, is present to the extent of 50 per cent. or more. A certain amount of moisture which always occurs in superphosphate can be found on analysis, but as the article offered for sale in New Zealand is now manufactured in dry, granular, free-running form to facilitate top-dressing, the moisture content is much lower than was the case when the manufacture was in the pioneering stages. Superphosphate when analysed also yields minor impurities (silicious matter, iron, and alumina) which occur in the original phosphate rock. However, the raw phosphates delivered to the various works at Auckland, New Plymouth, Wanganui, Christchurch, and Dunedin bear on an average over 80 per cent. of tricalcium phosphate, which indicates that they approach the maximum purity possible in rock phosphate.

With such a high degree of purity in the original rock the amount of impurities found in the resultant superphosphate is, of course, negligible.

Following is an analysis of high-grade superphosphate manufactured in New Zealand:—

	Per Cent.
Moisture (loss at 100° C.)	10·72
Combined water and undetermined	12·87
Silica (SiO_2), &c.	1·76
Lime (CaO)	28·38*
Iron and aluminium oxides (Fe_2O_3 and Al_2O_3)	0·84
Phosphoric anhydride (P_2O_5)	20·72
Sulphur trioxide (SO_3)	24·71*

(Analysis by the late F. T. Leighton.)

* Combined lime and sulphur in form of gypsum = 53·12 per cent.

How Superphosphate is Sold.

In England and on the Continent of Europe superphosphate is generally sold on the basis of its content of phosphoric acid soluble in water, although in some countries—United States, France, Belgium, Spain, and Russia—the sale is conducted on the basis of the phosphoric acid as determined by a cold alkaline solution of ammonium citrate in addition to the water-solubility guarantee. South Africa, Canada, and the Australian States also adopt the percentage of water-soluble phosphoric acid as the basis of sale. Packages of superphosphate in South Africa, for example, are required to be marked "Low grade," "Medium grade," "High grade," or "Extra high grade," according to whether such superphosphates contain respectively not more than 15 per cent., from 15·1 per cent. to 17 per cent., from 17·1 per cent. to 19 per cent., or over 19 per cent. of water-soluble phosphoric acid. If New Zealand superphosphate was sold in South Africa it would be designated as "Extra high grade," as its percentage of phosphoric acid is a little over 20 per cent. This further serves to prove that New Zealand is fortunate in being able to secure the highest-grade raw-rock phosphate obtainable for superphosphate manufacture.

The trade term "44–46 per cent., water-soluble" prefixed to the word superphosphate is liable to be misunderstood, as it is rather ambiguous. This form of expression has become firmly rooted, not merely in New Zealand but in some other countries as well, as a result of long usage by vendors in describing superphosphate in advertisements and circulars. To put the term plainly, it means that the percentage of phosphoric acid plant-food in this grade of superphosphate is equivalent to 44–46 per cent. of tricalcium phosphate. If stated in terms of phosphoric acid, soluble in water—which the buyer should always look for on the invoice certificate—the correct figure would be between 20 and 21 per cent. As will be seen from Table 3, the average plant-food content of high-grade superphosphate registered under the Fertilizers Act is 20·1 per cent. of phosphoric acid.

It may be mentioned here that the analysis on the invoice certificate must correspond exactly with the registered analysis. To provide, however, for slight deviations in constituents guaranteed, a limit of error of 0·75 per cent. is allowed by law above and below the percentages guaranteed in an invoice certificate or registration statement in respect of the actual amount of water-soluble phosphoric acid

Table 2.—Equivalents of Phosphoric Acid in Tricalcium Phosphate.

Plant-food expressed in Terms of Phosphoric Acid.	Plant-food expressed in Terms of Tricalcic Phosphate; also given as Phosphate or Total Phosphate.
Per Cent.	Per Cent.
15	Equivalent to 32·76
16	,, 34·94
17	,, 37·13
18	,, 39·31
19	,, 41·50
20	,, 43·68
21	,, 45·86
22	,, 48·05
23	,, 50·23
24	,, 52·42
25	,, 54·60
26	,, 56·78
27	,, 58·97
28	,, 61·15
29	,, 63·34
30	,, 65·52
31	,, 67·70
32	,, 69·89
33	,, 72·07
34	,, 74·26
35	,, 76·44
36	,, 78·62
37	,, 80·81
38	,, 82·99
39	,, 85·18
40	,, 87·36
46	,, 100·46
52	,, 113·57

NOTE.—The above tabulation is an extension of Table 3 printed in the article on Basic Slag in the *Journal* for May, page 331.

in superphosphate. Should a buyer at any time have good reason to doubt the *bona fide* nature of any type of fertilizer he has purchased he can send in a representative sample of such fertilizer, together with a copy of the vendor's invoice certificate, to the Chief Chemist, Department of Agriculture, Dominion Laboratory, Wellington, who will advise whether it is necessary for an official sample to be taken by an Inspector under the Fertilizers Act.

Another grade of superphosphate, usually styled 36–38 per cent. (in terms of tricalcium phosphate), is made by diluting the strength of the high-grade (44–46 per cent.) article with 18 per cent. of sand. The sale of this grade, however, has ceased in the North Island, and at the present time is almost off the market in the South Island. It should be explained that the breaking-down of the strength of superphosphate by the addition of small amounts of sand, &c., is quite a legitimate procedure, provided that the nature and percentage of the diluent employed is disclosed in the invoice certificate and registration statement. Diluents are regularly employed in several countries for standardizing the composition of fertilizers or for ameliorating their mechanical condition. In connection with the sale of diluted fertilizers it is known that many purchasers, having regard to price quotations, have preferred the lower-grade superphosphate to the higher grade, but it should be noted that the highest grade of fertilizer which will meet

individual requirements is the most economical to buy, since a greater percentage of purchase-price goes to pay for plant-food. For instance, as 1,600 lb. of 20-per-cent. superphosphate equals 2,000 lb. of 16-per-cent. super, the price of the former effects a saving in the cost of freight and handling.

Our lower grade of 36–38 per cent. superphosphate cannot altogether be classed as a low-grade super. As a source of phosphoric acid it is slightly superior to the superphosphate of European countries, where grades range chiefly between 30 and 38 per cent. In Denmark, for instance, sales of superphosphate are chiefly confined to the 39-per-cent. grade (18 per cent. phosphoric acid). This may no doubt be attributed to the choice of imported phosphate rock for superphosphate manufacture in Denmark being limited to a somewhat lower-grade type than the rock imported here from the Pacific Islands.

Sulphate of Lime in Superphosphate.

Hydrated sulphate of lime (gypsum) occurs naturally in vast deposits in different parts of the world. As previously pointed out, a good proportion of this material is found in superphosphate. Generally it is regarded as a highly desirable addition to heavy clay soils. About one-fifth of its weight of water, known as the water of crystallization, can be driven off when it is heated to over 250° C. and plaster-of-paris results. This substance is not used in agriculture, but is much valued in the arts on account of its property of making a white cement when mixed with the right quantity of water.

There appears to be some ground for supposing that sulphate of lime is a valuable source of lime to plants, as it is slowly but reasonably soluble in water; but since its lime is combined with sulphuric acid and is present in a neutral form—neither acid nor alkaline in action—it follows that it has no special value for treating sour or acid soils. For this purpose it cannot be expected to take the place of slaked lime or ground limestone. At all events it has the property of flocculating clay, and is held to exert some influence on the insoluble potash compounds of the soil by setting free the important plant-food potash in forms available for plants, such as clover. It is no doubt this virtue which makes sulphate of lime specially beneficial as a dressing for clover, a fact which explains to some extent why superphosphate is so effective in promoting clover growth under certain soil-conditions.

There appears to be considerable room for investigation of the properties of sulphate of lime as a soil-improver. At one time it was highly esteemed as a valuable mechanical agent by agriculturists, but now that it is supplied free in superphosphate and is not recognized by the Fertilizers Act it has almost been forgotten. There is reason to believe that the great efficiency of superphosphate cannot be attributed entirely to the water-soluble phosphate; it is highly probable that the sulphate of lime, combining the important elements lime and sulphur, exerts much more influence than has hitherto been thought It should be pointed out that sulphur, in combination as cystine, is an essential component of wool, and must be present in sufficient quantity in the soil to enable a good fleece to be developed.

Superphosphate and Soil Acidity.

In the United States superphosphate was for many years sold as "acid phosphate," but evidently this was considered an inappropriate definition, for the Association of Official Agricultural Chemists in 1929 adopted the official recommendation that the use of the term be discontinued.

A great deal of propaganda has been issued recently in support of the contention that superphosphate does not have any effect in rendering the soil acid. The opinions of noteworthy authorities have been quoted and the arguments have been convincing, so there is no need to bring the various aspects of the subject within the scope of this article. One point is quite clear—that well-managed soils will not be made acid in any way by the long and continued use of properly made superphosphate. Acidity of the soil may be related to lack of lime, a condition which can be remedied by dressings of lime, but such a condition should not be attributed to the use of superphosphate. Sir John Russell (*Agricultural Research in 1927*) has stated that a considerable number of tests were made with superphosphate by the Rothamsted Experimental Station staff in different parts of Britain, but even the most delicate methods failed to reveal any increase in acidity that could possibly affect the crop. Millions of tons of superphosphate have been sold annually throughout the world for a considerable period. If superphosphate in any way had a deleterious effect on soils, steps would no doubt have been taken long ago by some country or other to deal drastically with its sale.

Use of Superphosphate in Proprietary Mixtures.

Data giving the average registered plant-food content of some of the more commonly used superphosphates sold in this Dominion are presented in Table 3.

Brand registrations in respect of proprietary mixtures containing superphosphate or basic superphosphate as a principal constituent numbered 1,160, and all other fertilizers (including mixtures) numbered 723, making a total of 2,064 brands registered under the Fertilizers Act for the year 1930–31. The large number of brands sold is more or less accounted for by the fact that a great many merchants sell under their own particular brands and not necessarily those of manufacturers.

Table 3.—Average Plant-food Content of Various Superphosphates registered.

Number of Brands registered.	Fertilizer.	Nitrogen soluble in Water.	Phosphoric Acid.		Potash soluble in Water.
			Soluble in Water.	Insoluble in Water.	
		Per Cent.	Per Cent.	Per Cent.	Per Cent.
116	Superphosphate 44–46 ..	..	20·1	..	..
	,, 36–38 ..	..	16·5	..	..
65	Basic superphosphate ..	..	..	19·0	..
58	Potassic superphosphate ..	..	19·0	..	2·3
	,, ..	..	16·5	..	3·0
20	Nitro-superphosphate ..	1·3	17·1	..	..
39	Ammoniated superphosphate	6·0–6·5	11·0–14·0	..	..

REMARKS ON MANUFACTURE, ETC. (TABLE 3).

Superphosphate: Details have been given earlier in this article.

Basic superphosphate: This is prepared by mixing high-grade super with about one-seventh of its weight of slaked lime, thereby causing the water-soluble phosphate to revert to an insoluble-in-water form. Is more quickly assimilable to plants than ground rock phosphate.

Potassic superphosphate: The first mixture contains 95 per cent. of high-grade super mixed with 5 per cent. of sulphate of potash. The second mixture is a mixture of 90 per cent. high-grade super and 10 per cent. of potash manure salts (chloride of potash).

Nitro-superphosphate: A mixture of high-grade super and a small amount of sulphate of ammonia, and in some brands a little blood-and-bone.

Ammoniated superphosphate: This contains sulphate of ammonia and super in proportions of about one-third and two-thirds respectively. The phosphoric acid tends to revert to an insoluble-in-water form after prolonged storage.

Incidence of Fertilizer Manufacture and Practice.

The tendency of modern practice is to increase the concentration of fertilizer products for the purpose of saving freight and distribution costs. Going back as far as 1909–10, one finds from Departmental records that the superphosphates sold ranged from 10 to 19 per cent. in phosphoric acid contents. The year 1920–21 saw the quality go up a little higher—from 13 to 19 per cent.—and in 1930–31 the highest-grade superphosphate, containing over 20 per cent. of plant-food, is being sold at a very much lower price than what was charged during the year 1920–21. Proprietary mixtures consisting largely of superphosphate also show a distinct rise in grade.

In an effort to promote the more effective use of fertilizers and to furnish plant-food to farmers at a lower cost, a meeting of representatives of a number of experimental stations and various fertilizer companies was called in Chicago, U.S.A., in the autumn of 1922. At that meeting it was decided to reduce the number of mixtures on the market so far as possible and still meet all the needs of the farmers and other users of fertilizers. From the list a "standard set" of fertilizers was selected, particular attention being devoted to those which field experiments had indicated could be most profitably employed. This suggests that there may be a strong grain of truth in the idea that it is unprofitable to feed an unbalanced fertilizer to certain soils, in the same way as it is to feed an unbalanced ration to a dairy cow. Well-balanced fertilizer mixtures are of primary importance at the present stage of development in scientific agriculture.

According to Erhard Frederiksen, writing on "Fertilizer Practice in Denmark" (*English Fertilizer Journal*, 1st April, 1931) the three main plant-foods—phosphoric acid, potash, and nitrogen—are applied separately, and fertilizer mixtures are applied only to a very limited extent in Danish agriculture. Fertilizers are not applied on all farms, but the fact is that 75 per cent. of Danish farmers apply nitrogenous fertilizers, 80 per cent. use phosphates, and 43 per cent. employ potash fertilizers. In 1930 Denmark consumed 454,689 tons of superphosphate, 11,835 tons of basic slag, 225,087 tons of nitrogenous fertilizers, and 76,210 tons of potassic fertilizers. A rough comparison with available New Zealand figures for the year 1929–30 shows that 264,564 tons of superphosphate were manufactured in the Dominion,

and that some 194,000 tons or more of basic slag, North African phosphate, phosphatic guanos, &c., were imported mainly for direct application to the land. Potassic and nitrogenous fertilizers imported amounted to only 8,790 tons and 13,375 tons respectively. (The foregoing statistics do not take account of meat-works fertilizers in either case.)

These figures merely afford a rough comparison, nevertheless they serve the purpose of indicating the needs of "Mother Earth" in the two countries. There is, furthermore, reason to suppose that the future trend of developments in relation to the use of potassic and nitrogenous fertilizers in conjunction with superphosphate for soils in this Dominion will be of decided interest.

(Series to be continued.)

USE OF MEAT-MEAL IN CALF-FEEDING.

SOME RECENT EXPERIENCES BY FARMERS.

Live-stock Division.

Use with Whey.

Whey, in contradistinction to skim-milk, is very short of flesh-forming constituents or proteins. As an abundant supply of flesh-forming food is essential for the satisfactory growth of young animals, whey by itself naturally gives unsatisfactory returns in the feeding of calves, and there is a tendency to use unnecessarily large quantities. In the past whey has frequently been supplemented with pollard, oil, grain, &c., but as none of these are particularly high in protein they do not economically replace a high-protein food essential in increasing the nutritive efficiency of the whey.

The cheapest and most reliable protein-rich food for inclusion with whey for calf-feeding is meat-meal, now being prepared by most of the freezing companies at a price in the vicinity of £11 per ton, or roughly 1¼d. per pound. When purchasing meat-meal the analysis should always be demanded, and those containing from 56 to 60 or more per cent. of protein are recommended as the most suitable.

In general, whey-fed calves should when two weeks old get 2 oz. of meat-meal per day; when three weeks old, 4 oz.; when four weeks old, 6 oz.; and when five weeks old, 8 oz. per day. There is no real need to further increase the amount of meat-meal per day after the calves are five weeks old. Whether any mineral addition is necessary will depend on the analysis of the meat-meal used. Common salt should always be available. Where the analysis shows more than 8 per cent. of ash there should be no need to give lime.

Use with Skim-milk.

When skim-milk is used there is not the essential need to include a protein-rich food as is the case with whey-fed calves, but it is certainly advantageous to include a little meat-meal, particularly if

no other or very little other supplement is being used, in conjunction with the skim-milk. Farmers desirous of including meat-meal may use about one-half of the amounts recommended in connection with whey feeding.

Skim-milk contains about three and a half times as much protein as whey, and where skim-milk is available in quantity we recommend as supplements foods rich in starches, such as crushed oats, pollard, &c. If skim-milk is limited, meat-meal may be used for its protein, the starchy foods being also added. It must be remembered that the specific protein in milk is invaluable for young growing animals; also that, whereas excessive protein may make up for a deficiency of starches, excessive starches cannot make up for a deficiency of protein in a diet.

As protein-rich foods are dearer than protein-poor foods, an excessive use of meat-meal with skim-milk would be wasteful and expensive feeding; in other words, if protein is used in excess in animal nutrition, the procedure is not economical, the excessive nitrogen being excreted by the kidneys in the form of urea.

General Remarks.

It is particularly in the period before the calf can feed fairly extensively on grass that the value of meat-meal is most apparent, and also where grazing-conditions are poor throughout the duration of hand-feeding. The value of young vigorously growing top-dressed grass should not be overlooked. Such grass in New Zealand is generally high in protein, and this explains why many calves after they have reached a certain age thrive better than might be expected on whey and plenty of good grass. The following figures are of interest as a general guide in this respect: 100 lb. of whey contains 1 lb. of protein, 100 lb. of skim-milk contains $3\frac{1}{2}$ lb. of protein, 100 lb. of young grass contains 5 lb. of protein, 100 lb. of linseed contains 22 lb. of protein, 100 lb. of meat-meal contains 60 lb. of protein.

Calves are not so likely to scour where meat-meal feeding is taking place, but where this does occur it is a clear indication that too much whey or skim-milk is being fed, and the amount in such cases should be reduced. Skim-milk should always be fed when fresh or always sour, whichever method is customary. Alternately using the milk fresh and sour is a common cause of scours; preference should be given to its use when fresh. Calves should always have access to a supply of pure water.

It is obvious that improved feeding cannot be carried out unless the calves are fed in properly constructed bails, so that each individual calf gets its proper share of food.

Experience and Results in the Past Season.

During the past season advice on the foregoing lines was widely disseminated by field officers of the Division, and a considerable amount of information as to meat-meal feeding is now available.

Equally satisfactory results have been achieved where this concentrated foodstuff has been used with either whey or skim-milk.

Certainly in the collection of individual experiences over such a wide area a few reports of farmers were rather unsatisfactory, but on investigation it was found that these cases were attributable, in the main, to avoidable causes coming under categories as follows: (1) Defects in the meal itself, such as poor quality, too high a percentage of hair or other fibre, too high a percentage of bone, or too coarse particles of bone; (2) feeding too large quantities of skim-milk or whey; (3) insanitary feeding-utensils and a general low standard of management of calves; (4) feeding too great a percentage of meat-meal to start with, resulting in digestive disturbances and scouring.

As illustrating a case due to the last-mentioned cause, it may be mentioned that when the history of one case was investigated it was found that the farmer had commenced feeding 4 oz. of meat-meal per day with 2 gallons of warm whey. The result was unthrifty calves, but on regulating the ration the calves began to thrive.

HEIFER CALVES OF THE 1930–31 SEASON REARED BY MESSRS. TICKNER BROS., TAUMARUNUI, ON SKIM-MILK AND MEAT-MEAL.

In order to secure uniformly good results, only meat-meals containing a good percentage of proteins, free of hair or other fibre, and above suspicion in regard to their digestibility and assimilation should be used. This is important to the animal metabolism. Well-prepared liver-meals and the average good meat-meal have given results which compare very favourably with any other foodstuffs, and costs, where kept, have proved the feeding of those meals to be an undoubted economical proposition to the farmer.

The Inspector of Stock at Palmerston North has supplied some detailed information of actual results which is of distinct practical value for dairy-farmers and others. The following analysis of his figures will give an indication of the results obtained in the Manawatu district:—

(1) Twenty-five calves were weighed on 1st October, 1930, their average initial weight being 112 lb. They were again weighed on

26th January last, their average weight then being 275 lb. The average gain in weight is 163 lb. per calf, or 1·4 per day—a very satisfactory result. The greatest individual gains were 212 lb. and 209 lb., and the lowest 124 lb. and 140 lb. These calves were fed according to the recommendations by the Division. Being in the Manawatu district, the concentrates used were Longburn meat-meal and Longburn liver-meal.

(2) Thirty-two calves were weighed on 8th October, their average initial weight being also 112 lb. They were again weighed on 28th January, their average weight then being 276 lb. Their average gain over the period was thus 164 lb., or 1·46 lb. per day per head.

These figures speak for themselves. Other results known are consistently good. The following is a typical case, the calves being fed on whey plus meat-meal:—

Date Calved.	Weight, 1st October, 1930. lb.	Weight, 26th January, 1931. lb.
(1) 28th August ..	.. 100	265
(2) 29th ,, ..	.. 98	277
(3) 8th September ..	.. 96	261
(4) 10th ,, ..	.. 94	234
(5) 11th ,, ..	.. 96	259

Thirteen other calves were not weighed, as the scales would not weigh over 300 lb., and these were all over that weight. All these calves were reared according to a chart provided by the Division, lime and salt being added. It is interesting to note that this farmer estimates his total cost (exclusive of new milk given during the first fortnight) at less than 6s. per calf.

The following are examples reported from other districts:—

"A" reared eighty calves fed with the correct ration of meat-meal with excellent results.

"B" gave 1 oz. per feed per calf twice daily with great success.

"C" fed forty-three calves with 2 oz. meat-meal and 1 gallon separated milk; result very satisfactory.

"D" fed fifteen calves on linseed-meal and fifteen on meat-meal with whey. The meat-meal fed calves are far superior in condition to the others.

To sum up, the reports definitely indicate that where meat-meal is fed to calves correctly the results amply warrant its use.

Dairy Industry Legislation.—The first Dairy Industry Act was passed in 1892. In so far as they related to dairy-produce or dairies the Companies Act, 1868; the Public Health Act, 1872; the Food and Drugs Act, 1877; and the Factories Act, 1891, can be treated as ancillary to the Dairy Industry Act, and it would seem that the provisions of these Acts were the only provisions relating to dairy produce prior to the enactment of the Dairy Industry Act, 1892. A more comprehensive Dairy Industry Act was placed on the statute-book in 1894, repealing the Act of 1892. Other Acts were passed in 1898, 1903, and 1907, but all this legislation was consolidated in the Dairy Industry Act, 1908. Since then there have been amendments in 1915, 1922, 1924, and 1926.—*Dairy Division.*

WOOL RESEARCH IN ENGLAND AND SCOTLAND.

D. J. SIDEY, B.Ag., H.D.D., Canterbury Agricultural College.*

FROM the time of the Great War there has been considerable expansion in research work covering many phases of production and manufacture. The wool industry has been no exception to this general trend, with the result that to-day wool research is playing a large part in the manufacturing industry and is becoming increasingly prominent on the wool production side.

Wool, however, is in a rather anomalous position, because, although it has been used for centuries as an article of commerce and has been studied by scientists for many years, there is still much to be learnt about the fundamentals of the fibre. There remains a great deal more to be discovered regarding the growth of the various types of wool fibres, their physical and chemical properties, and their intimate characteristics. This is necessary before it will be possible to understand the variations in manufacturing performance which occur even with good wools. One fundamental fact that is of extreme importance to some New Zealand wool producers and which cannot yet be answered is why the wool follicle, from which the fibre grows, may produce at one time a normal fibre and shortly afterwards a badly medullated or hairy one. In the case of most of our domestic animals there is no such marked variation in fibre production, and the problem is why should the wool of the sheep be such an exception.

In recent years there has been a particular need for wool research because of the fact that wool has had to meet the competition of new and improved fibres, especially synthetic silk. At the same time there has been a demand for new and improved fabrics made from wool. During the last hundred years or so there has been remarkable progress in manufacturing methods, due largely to the initiative and work of the practical men in the factories. In regard to wool production as a whole, however, there has not been the same progress. In fact, it is questionable if within recent years there has not been a slight decline in the quality of the world's wool.

If wool is to meet the new competition and also the demands of fashion, there is an urgent need that the raw wool should be as true to type, as even in fibre characters, and as soft in the "handle" as is possible. At the same time, the manufacturing methods must be improved to make the best possible use of the wool, especially in the direction of producing lighter-weight materials and removing the objectionable prickly feeling from clothing which has to be worn next to the skin. Until our raw wool is improved it will not be possible to approach the same degree of uniformity of processing as is obtained with artificial fibres.

* Mr. Sidey has recently returned from Britain, where he spent some time studying wool research and the faults and manufacturing uses of New Zealand wools. His visit abroad was made possible by funds provided by the Department of Scientific and Industrial Research and the Empire Marketing Board, also through the release of his services by Canterbury Agricultural College, of whose staff he is a member. Mr. Sidey has made a full report, partly of a technical nature, to the Research Department. The articles he is contributing to this *Journal* are of a more popular character, for the special information of sheep-farmers and others interested.—EDITOR.

In most of the important countries of Europe wool research on the manufacturing side was in progress before the Great War, but it was confined, in the main, to educational institutions and combined with the instructional work. While there had been prior to 1918 a certain amount of co-ordination between the scientist and the manufacturer, notably in the Textile Department of Leeds University, it was not until the British Research Association for the Woollen and Worsted Industries, later known as the Wool Industries Research Association, was founded in 1918 that science and practice were brought more closely together. This association, which represents all branches of the many-sided wool industry, was originally financed largely by the industry with some aid from the British Department of Scientific and Industrial Research. In recent years the Empire Marketing Board has assisted with the finance, and the chief wool-producing Dominions have also made contributions.

The original research activities of the association were confined chiefly to the manufacturing side of the industry, but after a few years it was evident that before satisfactory answer could be given to some of the manufacturers' problems it was necessary to know something more about the fundamentals of the wool fibre, and also to know what were the wool producers' problems. The result is that to-day the activities cover all phases of the complete wool industry, from the production of the fibre in the follicle to the finishing process of the final material.

The Torridon Research Institution.

The institution of the Wool Industries Research Association, of which Dr. S. G. Barker is Director, is established at "Torridon," Leeds, Yorkshire, and some particulars of the various branches of the organization may now be given.

In the Biology Department the work is mainly concerned with problems of fibre-growth and genetical studies. In this connection the results of the work of Miss Strangeways on the growth of hair "in vitrio," and her study of hair-growth on the living animal (guinea-pigs have been used so far), should prove interesting and useful to those engaged in research on the production side. The work of Fraser Roberts on the "Inheritance of Kemp in the Welsh Mountain Breed" is also of direct interest to the wool producer. Dr. J. E. Nichols, who visited New Zealand a little over two years ago, has now completed his Empire wool survey, and his report, when published, should be helpful when formulating schemes of wool research in the Dominions.

The work of the Chemical Department covers a very wide range, but the activity of chief interest to the New Zealand woolgrower is the endeavour to produce a branding fluid which will last from shearing to shearing on the fleece and yet will scour when the wool reaches the mill. The results up to the present may be said to be irregular, but workers are engaged on new formulas to endeavour to produce the ideal fluid. Very good results were obtained in South Africa in one season, but the results of Australian and New Zealand tests to date have not been so satisfactory. This department, together with that of Biochemistry, has made considerable investigations into the chemical nature of the wool fibre, particularly with respect to its sulphur content. This work appears to have some bearing on the question of the

production of medullated fibre in certain New Zealand wools, and will be discussed more fully in a subsequent article. The Biochemistry Department has also done some interesting work on the question of wool yolk, with special reference to the condition that is generally known as "dead yolk."

The Wool Measurement Department has done considerable work on the size and shape of the fibres of various wools. The fact that they have been able to show that a wool heavy in grease is a better spinning wool, because of the greater regularity of the shape and size of its fibres, than a wool of equal count but with less grease is of interest to the primary producer. It indicates that there should possibly be a tendency to select towards a little more grease in some of our wools if there is to be an improvement in their spinning-quality and handle. The workers of this department have also been able to show that, other things being equal, there is a general tendency for a wool that is moderately round and even in fibre to be a softer handling wool than a wool with more irregularity. This means that if in selecting the breeding-stock more attention is paid to the handle of the wool there will be a natural tendency to produce a wool with the greater regularity of fibre for which the manufacturer asks.

The Physical Department is concerned mainly with manufacturers' problems, although it has developed a machine for testing the strength and elasticity of wool fibre. This type of machine is essential for investigations into the effects of different classes of feeds on the fibre produced by sheep. The investigators have also shown that in normal well-grown wools crimp-formation is a simple periodic function of time. This means that a certain number of crimps are produced in any given time without regard to the length of fibre produced in the same time.

The Technical Department has interested itself in the production of new and improved woolpacks to overcome the objections to the present jute-fibre packs. At present attempts are being directed to the production of a pack made from paper twine, which is not so detrimental to the wool as is jute, because should any of the material get as far as the scouring-bowl it absorbs water, disintegrates, and is removed during manufacture. However, when hooks are used on these packs they tear rather easily, even when a thin wire is used to strengthen the paper twine. This department has also perfected means whereby it is possible to determine the affinity of any wool for dye-stuffs, and has shown that "tippy" wools dye a distinctly deeper shade at the tip than do normal wools. This is important to the grower, as it demonstrates one of the reasons why such wools should not be produced.

The Bacteriology Department has been able to demonstrate that many of the coloured wools are due to bacterial action. At the present time work is being done on "canary yellow" wool, which is said to be increasing in our New Zealand clips. While it has been possible to isolate bacteria that do produce a bright yellow coloration on culture media, it has not been possible so far to persuade them to reinfect normal wool. This is hardly surprising in some ways, since it may be at a certain combination of temperature, humidity, and pH (active acidity) conditions, that their effects colour the fibre.

Other departments within the association are those concerned with woollen carding and spinning, worsted spinning, and colour and dyeing, together with a library and abstracting service. This latter is helping to fill a much-needed want in all branches of the industry. It may be remarked here that the work of the association might quite well be extended considerably on the economics side: one of the greatest needs of the wool industry to-day is better statistics.

The foregoing account has been confined mainly to the Research Association's work as it affects the primary producer (for whose information chiefly this article is written), and it can be seen how varied the work is. In addition, every department is continually working on some manufacturing problem or phase of research. Since the management of the association is largely in the hands of the manufacturers, and it is situated in a manufacturing country, there is a natural tendency towards more emphasis being placed on manufacturing problems than on those connected with production and the fundamentals of the fibre. A number of manufacturers, however, are now alive to the importance of the latter aspect.

Leeds University and Technical Colleges.

The Textile Department of Leeds University has been interested in the various phases of wool research, both on production and manufacture, almost from its opening. Professor A. F. Barker, who is Director of this department, has investigated the wools of various breeds of sheep in different countries and has conducted manufacturing tests on a wide range of wools. Dr. Dry, of Massey Agricultural College, whose recent research work in connection with Romney wool is well known to many New Zealand woolgrowers, spent some years in this institution. His studies in connection with the occurrence of black-woolled animals in the Wensleydale breed are a valuable contribution to the knowledge of sheep genetics. In the Textile Department research work on the manufacturing side is combined with the instructional work of the institution. In recent years research workers, notably Mr. Spackman and Mr. Asbury, have carried out considerable fundamental research into the structure of the fibre, and their results should have a direct bearing on future wool research.

Leeds University and the Torridon institution have both interested themselves in the work of the British Joint Committee on Sheep-breeding. This committee was formed with the object of improving the wool of British breeds of sheep, and has carried out experiments with this object in view. It cannot be claimed, however, that the results of these experiments have been very encouraging. This is partly due to the fact that the soil and climatic conditions are not favourable for producing high-class wool in those parts of England and Scotland where breeding primarily for wool is economically possible.

The Textile Department of the Bradford Technical College has also combined research and instructional work for a number of years. Their research work has largely followed the lines of finding more economic uses for various types of wool, together with efforts to help in solving various manufacturing problems. By modifications of existing machines they have been able to manufacture from cheap crossbred noils (short

fibres removed during the combing process) a yarn that has some superior characters to the yarn produced from full-staple wool.

Each wool manufacturing centre in England and Scotland has its own technical college where apprentices and others engaged in the industry may receive instruction in manufacturing methods. These colleges do a certain amount of research work, usually of an elementary nature, for the manufacturing side. It is regrettable, however, that some of these institutions are not fully alive to the fact that fundamental research is of paramount importance to the wool industry.

Research on Sheep in Scottish Institutions.

All the institutions mentioned so far have a direct connection with the manufacturing industry, but in Scotland there are two at which research is confined to sheep and other animals. These are the Animal Breeding Research Department of Edinburgh University and the Rowett Research Institute at Aberdeen. The former has been associated with sheep investigation for a considerable period, the work having been started by Professor Cossar Ewart many years ago. Ewart's work was mainly a study of primitive breeds of sheep and their fleece characters, together with a certain amount of genetical study. This has since been continued by other workers under Professor Crew's direction. The study of colour inheritance, while probably not of immediate application to the sheep industry, is of indirect value as a contribution to the genetics of the sheep. Other genetical work at Edinburgh is concerned with the inheritance of kemp and other fleece characters, together with face colour and spotting of the Scotch Blackface breed. Since the latter has a type of fleece not found in the more developed breeds, this phase of the work is chiefly of local interest, but, like colour inheritance, it is a valuable contribution to genetics in general. Professor Crew takes the very wise point of view that in any wool research it is necessary to consider the sheep as a whole, as, after all, the fleece is really a by-product.

In recent years Mr. W. C. Miller has been studying the effects of physiological and endocrinal agencies on fleece characters and the general life of the sheep. Such work is extremely valuable, and, while yet in its infancy, it promises interesting results. For example, the removal of the thyroid gland from the Scotch Blackface causes the coarse, heavy, outer-coat fibres to thin down considerably, take on more the appearance of normal wool, and lose at least part of their medulla. Some stud-sheep breeders in New Zealand claim that when they get enlarged thyroids in Romney lambs the sheep so affected produce an abnormal amount of medullated fibre. If this is true, then it shows that the thyroid has some controlling effect on the production of the wool fibre, and may be a contributing factor to the production of so much coarse, hairy fibre in certain districts of New Zealand.

The staff of the Rowett Research Institute, while interested in animal-nutrition in general, are engaged chiefly in studying problems as they affect the mineral metabolism of the animal. So far as sheep are concerned, there has not been a great deal of work done, and so far the results of their experiments have not been published in full. At the present time an experiment is being conducted to find the effects

of diets high and low in protein on the general health of the animal, and the weight and characteristics of the fleece. The results of this work are awaited with interest on account of the prominence that has been given recently to the necessity for protein, especially when rich in cystine, for wool production. A certain amount of work has also been done on the effects of feeding a supplementary ration rich in proteins and mineral matter to the sheep grazing on the hill pastures of Scotland. Progress results show that undoubted benefits do follow this feeding, and it is now a question if the return and benefits are sufficient to pay for the feed and labour involved.

Mr. W. Godden's work on the analysis of the mineral content of pasture grass is too well known to require any elaboration here, and, while it has no direct bearing on wool research, it has an indirect application on account of the effect of minerals on animal growth and health. It may also have a more direct application, for Mr. Godden pointed out to the writer that manuring with sulphate of ammonia increases the percentage of sulphur in the grass. Whether the increase was in the organic or the inorganic sulphur Mr. Godden was unable to say. This may be important to sheep-raisers, since recently much attention has been focussed on the probable importance of organic sulphur compounds in the nutrition of sheep if maximum quantity and quality of wool is to be produced.

Wales and Cambridge.

The University College of North Wales is interested in wool research. It is here that Fraser Roberts, of "Torridon," has carried out, in co-operation with Professor White, his breeding-work on the inheritance of kemp in the Welsh Mountain breed of sheep. The average fleece produced by this breed contains a very high percentage of kempy fibres, and work was started to endeavour to eradicate them. In this case kemp serves no useful purpose in the adult fleece, but its predecessors, "birth-coat" kemps, do fulfil a useful purpose in helping to protect the new-born lamb from severe mountain storms. It has been necessary, therefore, to observe the various types of birth-coats and find out which type, while still giving sufficient protection to the young lamb, is followed by a minimum of kemp in the adult fleece. This has now been accomplished, and by using the results obtained a few stud flocks are being bred wherein the sheep have relatively few kemps in their fleeces.

The School of Agriculture, Cambridge University, is also doing work of interest to the sheep-breeder, but it is mainly in the direction of animal diseases and feeding, together with the conservation of fodder. Some years ago the late Professor T. B. Wood did some useful and interesting work on the inheritance of certain characters of the sheep. Professor Engledow, with P. G. Bailey, published an article on quality in wool, but unfortunately this work has not been continued. In the Chemistry Section considerable work has been done on the nutritive value of grass at various stages of its growth. The results have shown that young grass is considerably richer in protein material when compared with grass allowed to grow rank, and, as has already been pointed out, protein is very essential for wool production. This work is being extended to include analysis of the grass for sulphur

content, a very important phase of the work as far as wool is concerned. The Institute of Animal Pathology, attached to Cambridge University, is also doing work on the control of sheep-diseases.

General Considerations.

With all this research going on in Britain, it appears strange that there is not more enthusiasm displayed by the sheep-breeders or the manufacturers. The woolgrower complains that the manufacturer does not differentiate in price sufficiently between good and bad quality wool, and that the returns from wool are so poor that there is no incentive to improve the clip. He forgets, however, that because returns for wool are low it is no excuse for not endeavouring to improve them by increasing the quantity of wool and improving the quality. Attempts made to improve the British wool-clip have in some cases failed because due consideration was not given to the sheep as a whole and all the factors involved in wool production.

Many of those engaged in the manufacturing industry are traditionalists who are slow to take up new ideas, and so it is little wonder that they do not always approve of research or adopt its findings. Some manufacturers are often loud in their condemnation of the raw wool, but they make little effort to improve their machinery and methods to use the class of wool it is most profitable to produce. The sooner all manufacturers realize that, unless something unforeseen happens and we are able to control climatic factors, it will never be possible to overcome some of the variations in the raw material, the better it will be for the industry as a whole. Improved manufacturing methods are just as important as improvements in the wool itself; and so the manufacturer must do his share in an improvement in the complete industry, from the growth of the wool on the sheep until the final manufactured article leaves the warehouse.

It may be asked, Has research work done anything that is helpful to the woolgrower in his endeavour to produce that class of wool which will net him the best return? While the answer is in the affirmative, it must be realized that before the results of such research can have their maximum effect the farmer himself must pay more attention to his general management and to his breeding methods. Undoubtedly much of the New Zealand wool that has been so severely criticized by manufacturers has resulted from the accumulation of the effects of bad breeding and mismanagement that have often obtained in the past.

Further articles will deal with the faults of New Zealand wools, with suggestions for their improvement.

Grassing Riverbed in Westland.—The local Fields Instructor reports good use made of an area of rough river-bed at Kokatahi. When the worst boulders had been removed the ground was dressed with 2 cwt. of super and 7 cwt. of lime per acre, surface-sown with grass and clovers, and tripod-harrowed. A fine sward resulted, capable of carrying at least three sheep to the acre.

SCALD AND FOOT-ROT IN SHEEP.

AN EXPERIENCE AT WALLACEVILLE.

C. S. M. HOPKIRK, Officer in Charge, Wallaceville Veterinary Laboratory.

FOOT-ROT in sheep is usually divided into two varieties—one a condition of necrosis of the foot following scald between the claws; the other a condition of eruption along the coronet, which sometimes results in loss of the hoof or in sinuses into the foot, and which is known as malignant or contagious foot-rot. Malignant foot-rot is only rarely observed among sheep in New Zealand, and may, until more has been seen and until material has been received for investigational work, be side-tracked. For the time being it is mentioned only to attract the attention of sheep-farmers who may come across it, in the hope that they will let the Wallaceville Laboratory have specimens.

Foot-rot resulting from scald is common. In late April and in May of this year a bad outbreak of this condition was experienced among breeding-ewes on the Laboratory farm. It was originally assumed that the ewes, having travelled through a double gateway where foot-rot-affected sheep are usually dressed, had picked up infection at that spot. Later, as a result of the inability to transmit infection to other sheep by means of cultures of material and by rubbing in infective material, the first assumption had to be reconsidered.

The first indication of trouble was that seven days after being put into a fairly poor paddock, following a period on good pasture, a few of the ewes were noticed to be lame. The following day a large number showed lameness, and a thorough examination revealed 60 per cent. with scald in one or more feet. In some the initial stage of redness was to be seen; in others there was a dampness superimposed. At a later stage there was necrosis along the inner walls of the claws, involving the soft horn of the heels and underrunning the harder horn nearer the toes. As the trouble advanced, bleeding from the necrotic parts of the foot where they had cracked was often seen. If healing was not affected at this stage, underrunning of the horn of the inner wall of the hoof and of the sole from the heel forward took place, and this proved extremely difficult to deal with. The latest stage was complete separation of the sole, and typical old-standing foot-rot where the necrosis had proceeded up the sensitive laminæ towards the coronet all round the hoof, and there appeared to be every chance of the hoof coming right off as a result. It is this chronic deformed condition which is frequently seen in ewes and rams and which requires so much attention in wet and cold weather.

As this experience showed that 60 per cent. of the ewes became infected together, and that only a few not found scalded at the first inspection ever became infected, one finds it difficult to postulate the reason for the outbreak, but there must have been some factor common to all which allowed the secondary bacterial action to take place. The weather had been dry but frosty during the fortnight before infection, and the paddock in which the sheep were running was not, at the time, particularly damp. Therefore one wonders if the rich paddock could have been in any way predisposing.

Once scalding occurred the predominant organism causing necrosis was the one known as *Bacillus necrophorus*. No spirochætes, such as European workers claim are always present and which are seen in association with *B. necrophorus* in ulceration of pigs in New Zealand, were to be seen. *B. necrophorus* is an organism which burrows into tissue, causing death of the part and leaving behind it a very unpleasant smell and a greyish type of dead tissue. This dead tissue does not necessarily slough away; consequently, whatever material is used in dressing the area may very easily be kept from contact with the deep inner active front, and so is actually useless. Therefore one sees the necessity for drastic paring of such areas to allow chemical disinfection.

The Department of Agriculture has for years advocated copper-sulphate solution for such conditions, and in the present case, after trying many forms of treatment, copper sulphate stood out as by far the most efficient of those tried. The ewes were all hand-dressed, the materials used being kerosene, carbolized oil, brilliant green as a watery solution and in a paste with lanoline, subacetate of lead in oil, creosote ointment, petrol and iodine, and a drying-powder containing starch, zinc oxide, and potassium permanganate. Finally copper-sulphate solutions were resorted to.

Oily dressings and pastes were found to be useless; they did not adhere well and had no effect when adhering; they will not penetrate. Brilliant green in a watery solution had a good effect, but could not be used in a foot-bath because of the danger of discoloration of the wool. Kerosene, and petrol and iodine, though penetrating, were not effective. The powder was useful only in the early stages, but once the bacillus of necrosis had commenced burrowing it was useless.

Copper sulphate was used in a very strong solution—a saturated solution made by crushing the crystals and allowing them to soak, with occasional stirring in a porcelain dish, in water for a day before use. By this time a few of the sheep had healed up, but 50 per cent. were still showing some signs of scald, or had become so bad that the sole was completely underrun and could be pulled right back. After a couple of treatments over a period of five days only a dozen ewes were left, and these were intensively treated for a week. At time of writing, some of these ewes have typical chronic foot-rot, but have improved under treatment.

The Laboratory farm flock is a small one, and it is realized that where a large flock suddenly develops severe scald there is nothing to do but (1) put the sheep into a dry, short-grassed paddock and trust that the majority will get over it without untoward results, or (2) put the sheep through foot-baths of strong copper-sulphate solution.

From the experimental work done with cultures and material scraped from affected feet and placed on sheep running apart from the flock, it would seem the condition of scald is not contagious, but follows on some other factor which in the present instance could not be traced.

High Yields of Wheat.—Some big yields were reported from the Morven district of Canterbury in connection with the last wheat harvest, the highest being 83 bushels per acre. One local farmer threshed 83 bushels of Bell's Hunters variety. This was a certified line, and sold at 6s. 6d. per bushel for seed.

RECENT WORK ON CHEESE AND BUTTER BY THE DAIRY RESEARCH INSTITUTE.

Address by Professor W. RIDDET, Director of the Dairy Research Institute (N.Z.), at the National Dairy Association Conference, New Plymouth, June 26th, 1931.

DURING the past dairying season the Dairy Research Institute at Palmerston North has continued experimental work on the manufacture of butter and cheese. Most attention has been directed to cheese, but some effort has also been devoted to butter problems. The cheese investigations were at the outset of experimental work in 1929 specially concerned with openness in texture; but as time has progressed these have developed into a study of cheese quality in general, since the consideration of texture is inseparable from that of other factors. Thus results have a direct bearing upon flavour, body, texture, colour, and maturity. Special attention has been given to factors bearing upon openness, harshness of body, and mature flavour, which are all engaging the attention of those interested in the cheese industry. Butter experiments have been mainly concerned with the use of starters to produce a mild "full" flavour without endangering keeping-quality.

Cheese Experiments.

I propose discussing the nature and results of our experiments bearing upon dairy-factory policies, rather than technical details of manufacture which are the special interest of factory-managers. In particular, I wish to refer to the relative merits of raw and pasteurized milk for cheese-making, the quality of the milk-supply, the general effect of manufacture on quality, the influence of maturity on flavour and texture, and the necessity for the careful handling of cheese at all stages.

Before dealing with each of these in detail it would make later explanations clearer to define briefly the nature of the troubles we are attempting to solve. Types of openness were explained in detail at last year's conference. A good Cheddar cheese should be close in texture, but three distinct types of openness are common—namely, mechanical, slit, and fermentation.

Experimental evidence strongly suggests that mechanical holes are present in the cheese when it comes from the press, while slits and fermentation openings are subsequent developments. No definite statements can be made with regard to the actual formation of mechanical holes; they are liable to occur at any time, but are particularly subject to arise in "slow" cheese. There is reason to believe that their cause is not *entirely* mechanical—*i.e.*, brought about by lack of pressure; though the lack of care in packing curd in hoops is a factor, the bulk of evidence is that the major trouble is the chemical state of the curd when put into the hoop.

The development of slit openness takes particular lines. A cheese containing layers of curd coloured with annatto after drying and milling, to make plain the outlines of curd particles, shows two main points: (1) The slits take up certain lines more or less parallel to the ends, or form broken curved lines arising from the sides of the cheese; (2) the openings often arise inside the pieces of milled curd. The former shows

the trend of development, while the latter illustrates the fact that the openings are not always due to lack of cohesion of curd, or to the mere contraction of particles as moisture exudes from the cheese. By cutting sections from a cheese at intervals after it has been removed from the press it can be observed that these slits generally develop in from three to twenty days after manufacture. The study of reasons for this fairly regular arrangement of distinct lines of cracks is now engaging attention, as well as factors affecting the condition of the curd primarily responsible.

Fermentation holes arise in very "sweet" pasteurized milk cheese, and they are liable to occur commonly in raw-milk cheese. In *very* sweet cheese these fermentation holes predominate. They arise during the curing of the cheese. Slits are the commonest type of openness. Fermentation holes are least common.

Harshness is a term applied to cheese body to indicate a coarse feel when the cheese is rubbed up in the fingers. A harsh body may feel rubber-like, gritty, or sandy. In good cheese is required a smooth body which rubs up like velvet and is not pasty. A harsh-bodied cheese tends to crumble to pieces when cut.

A mature cheese flavour cannot adequately be described in words. There is, unfortunately, no chemical method of accurately defining real Cheddar flavour. It can only be judged by experience.

Pasteurization of Milk for Cheese-making.

Since fully 90 per cent. of New Zealand cheese-factories pasteurize their milk, whilst most other countries selling produce in the British market manufacture cheese from raw milk, the Dairy Research Institute began its investigations with a study of the effects of pasteurization of milk on cheese quality. The results are interesting, particularly since the belief has often been expressed of late that all present difficulties are attributable to pasteurization.

The experiments extended from January, 1929, till 1st May, 1929, and from January, 1930, till 1st May, 1930. In all, cheeses from 109 days' make have been compared. The experiments were so arranged that (*a*) the pasteurized- and raw-milk supplies were drawn from the same bulk raw-milk supply; (*b*) cheeses of the same size were made; (*c*) different temperatures of pasteurization were used over the period; and (*d*) pasteurization of milk by the regenerative "flash" method exclusively practised in New Zealand could be compared with pasteurization by the Holding or Batch method adopted with market milk to avoid chemical changes and alteration in flavour. The milk-supply was drawn partly from the Massey Agricultural College herd and partly from a supplier to a factory some distance from the experimental factory. Arrangements were also made with a commercial factory to manufacture, over a period of ten days, raw-milk cheese and pasteurized-milk cheese from the same bulk supply. In addition to these direct comparisons of cheeses from the same bulk supply daily, there have been made at different times during the present season raw- and pasteurized-milk cheeses. Both full-cream and standardized cheeses have been made. The following conclusions have been drawn from these experiments:—

(1) Pasteurization of milk has neither caused nor prevented the development of mechanical or slit openness. Even when high pasteurizing

temperatures (over 165° F.) so altered the curd that it was brittle, lacking in cohesion, and would not cheddar properly, the mature cheeses did not differ from the corresponding raw-milk cheeses in closeness. During the trials close or comparatively close cheeses were made on some days, and open cheeses on others. When open texture appeared in the make of any one day it affected both raw- and pasteurized-milk cheeses on the average to the same degree.

(2) Differences in flavour have been observed. These are dependent on the temperature of pasteurization and the purity of the milk-supply. Taking the whole series of experiments into consideration, the cheeses from milk pasteurized at temperatures not exceeding 160° F. graded the higher at the age of three to four months, being then on the average cleaner in flavour. Out of a total of sixty-eight cases the flavour of the raw-milk cheese was preferred in seven cases, the pasteurized in forty-one cases, and they were equal in twenty cases. A certain number were held till they were more mature, when those cheeses made from finest grade raw milk developed the fuller Cheddar flavour. On the other hand, cheeses made from raw milk of lower quality had less desirable flavours than those made from the corresponding pasteurized milk. When the milk was pasteurized at such temperatures (generally above 160° F.) that the milk and freshly made cheese had a slightly or distinctly cooked flavour, the mature cheese had usually an undesirable flavour, generally bitter and acid and altogether lacking in true Cheddar character. When the milk was pasteurized above 160° F. the flavour of the raw-milk cheese was preferred in six cases, the pasteurized in seven cases, and they were equal in nine cases.

(3) Differences in body were brought about by pasteurization. In most instances, when a pasteurizing temperature of more than 165° F. was used, the body of the mature cheese was soft, pasty, and gritty. At temperatures of less than 165° F. no marked differences in body were observed. In total grading points of forty-one pairs of cheeses the raw-milk cheese graded better in six cases, the pasteurized in twenty cases, and they were equal in fifteen cases, when the pasteurizing temperature was 160° F. At a pasteurizing temperature of 160–175° F., in fifteen cases the raw-milk cheese graded better in body, in three cases the gradings were equal, and in only one case was the pasteurized-milk cheese preferred at this temperature.

(4) Pasteurization effected a better distribution of fat throughout the cheese without increasing fat loss. Cheese made from high-testing whole milk frequently contained visible pockets of fat, while that made from the same milk after pasteurization showed much fewer and often no fat-pockets. It is impossible to state the maximum milk-test which will not produce fat-pockets, since this varies with the period that the cows producing the milk have been in profit. As the milking season progresses the tendency for pockets to arise decreases with milk of any test. Thus they may appear in the spring months from milk with a test of, say, 4·2, which may not produce them in the late summer or autumn.

(5) Yields were affected by pasteurization. At temperatures of from 150° to 165° F pasteurization of milk increased the cheese yield on the average by 0·02 per pound fat based on fourteen-day weights.

At a pasteurizing temperature of 175° F. the cheese yield was increased by 0·1. It is to be noted that this increased yield was entirely offset by marked deterioration in quality.

(6) The yellowish colour of cheese made from high-testing milk was slightly reduced by pasteurization of the milk.

(7) No benefits were derived from pasteurizing milk in a cheese vat by the batch or holding method, which requires the milk to be held for thirty minutes at a temperature of 140°–150° F. More difficulty was experienced with cooked flavours in the immature cheese and bitter flavours in the mature product, and more time was taken up in the process.

Practical Recommendations arising from these Experiments.

Any move in the direction of the manufacture of raw-milk cheese must be preceded by an improvement in the raw-milk supply, which it seems can only be obtained by milk-grading and differential payment based on grade. This preliminary is absolutely essential, otherwise produce will lack uniformity in quality from day to day consequent on the variability of the purity of the milk-supply with weather and care in production, and considerable difficulty will be experienced with unclean flavours and fermentation openness. Raw-milk cheese is particularly subject to rancid and "stinker" flavours when the milk quality is not sound. Besides, food-flavours are more distinct in raw-milk cheese. After the milk-supply has been satisfactorily cleaned up, the possibility of development of numerous fat-pockets should be avoided by not manufacturing into raw-milk cheese milk of such test that will produce marked evidence of these. Factory-managers must use discretion in this, being guided by the maximum test of the milk they may safely use as the season progresses.

Meanwhile, any widespread return to raw-milk cheese manufacture is not advisable till the milk-supply is adequately improved, as indicated by grading over some period of time. Furthermore, particular attention should be devoted to temperatures of pasteurization. Flash temperatures less than 150° F. should be avoided; but temperatures should be kept as near to 150° F. as the purity and flavour of the milk-supply will allow. Since it is known that high pasteurizing temperatures definitely spoil true Cheddar flavour, and it is equally well realized by makers that temperatures are subject to fluctuation in the process of pasteurization, special care should be taken to avoid these fluctuations and to be prepared for their results.

Means of Avoiding Fluctuations.

In addition to careful control of the flow of milk and steam to the pasteurizer, great care should be taken to use accurate thermometers. Many cheap types with thick glass have been shown in work at the Institute to be not sufficiently sensitive to register momentary fluctuations in temperature; many gallons of milk may pass through the pasteurizer at a higher or lower temperature before the mercury column registers the alteration. Thus good sensitive thermometers should be used. Better still are good and accurate types of long-distance-recording thermometers. They are very sensitive, if of good make, and record on a graph, enclosed in a container fitted to a wall or any

suitable fixture, the temperature fluctuations of the milk in the pasteurizer during the whole run of the machine for the day. The records provide the manager with an accurate means of checking the temperatures of pasteurization, and also the washing and sterilizing of the machine. They can be preserved for reference in attempts to trace back causes of adverse reports on cheese flavours and general quality. Their initial cost is low in relation to the benefits to be derived from their use.

Quality of the Milk-supply.

All research investigations emphasize the importance of the quality of the raw-milk supply. There is no definite evidence of the influence of the chemical quality, though, apart entirely from consideration of the test of the milk and the casein it contains, there is considerable reason to suspect that the chemical condition of the casein and mineral matter has a considerable influence on the resulting cheese. There is ample evidence, however, in support of the necessity for a pure-milk supply—namely, one as free as possible of germs. This is so whether the milk is pasteurized or not before it is made into cheese. It must be remembered that germs commence their destructive work on the milk solids as soon as they enter the milk, and they multiply very rapidly, particularly in uncooled milk. Although pasteurization subsequently destroys many of these organisms it cannot restore the affected milk solids to their original state.

Pasteurization no Excuse for Lack of Care in Producing and Handling Milk.

Good-quality milk can only be obtained if care is taken at every step in the production and handling of milk to avoid the entrance of germs. No strainer can remove germs, for they are much smaller than the pores of the finest dairy strainers. Yet strainers should be used to remove visible dirt. Care in production involves cleaning of udder and teats before milking, avoidance of the use of odoriferous curatives for sore teats and the like, the rejection of milk from any quarter affected with mammitis or other udder trouble, the keeping of machines and cans clean, and the cooling of milk over a water cooler as soon as the milk is drawn. It is important that milk from diseased udders should not be included in the factory supply. If both hand and machine milkers adopted the simple practice of drawing the first two streams of milk (which contains practically no fat and thus is no loss to the farmer) from each teat into a separate bucket, signs of disease in the udder would be noted by the presence of thick milk. Milking-machines should be thoroughly washed and sterilized with boiling water or steam after each milking. Badly cleaned milking-machines harbour most harmful types of germs.

Improperly washed cans are another common source of milk-pollution. Cans and lids should be well washed with cold water and sterilized with boiling water or steam at the earliest opportunity after milk has been emptied from them. Hot water carted back to the farm from the factory is absolutely valueless for sterilizing purposes; this pernicious practice calls only for condemnation. When whey is returned to the farm in the milk-cans the chances of milk contamination are magnified, for the whey tank can be a hot-bed of pollution. The most

thorough scalding and preferably steaming of these cans is imperative. There is much to commend the Southland practice of washing and sterilizing cans at the factory and prohibiting the carting of whey in milk-cans. I realize that the whey-disposal problem is a big one; but it is surely not insurmountable if dairy factories are sincere in their endeavours to avoid milk-pollution from whey. It might be possible to overcome this difficulty by establishing pig-farms to utilize the whey from one or more factories.

Milk-cooling is another most important point. Failure to cool the evening's milk gives much trouble in cheese-making, particularly in raw-milk-cheese manufacture. Nothing short of good cooling by water or some other refrigerant is adequate. If cooling cannot be carried out on the farm, factories might seriously consider the requiring of suppliers to deliver their milk to the factory twice per day during hot weather.

Safeguarding the Milk-supply.

It is safe to say that in every factory there are to be found suppliers forwarding milk of first-grade quality. Unfortunately, this milk cannot be treated separately, but becomes polluted with second-grade milk from other suppliers, which thus lowers the quality of the whole factory milk-supply, and lowers the quality of the whole output of cheese. Milk-grading, accompanied by a differential rate of payment for milk according to grade, is the most effective means of raising the average quality. A differential rate of payment is not an imposition on the factory; it calls for no additional expense; it is only a fine on the careless producer, who rewards the careful man for his work. For all practical purposes recognized milk-tests are sufficiently accurate. Any that may be used should take account of the flavour of the milk and of the *number* and *types* of germs it contains. By smell and taste milk obviously unfit for cheese-making can be at once detected and food-flavours can be noted. By no other means can food-taints be noticed. It is necessary to get an indication of the numbers and types of germs in milk, because they bring about changes before these are noticed by the senses, and, although unobserved in the fresh milk, their effects become apparent in the process of manufacture.

Two simple tests are available that can be used in factories—namely, the reductase test (commonly called the methylene blue test) and the curd test. The reductase test is a measure of the number of bacteria, and the curd test of types. The microscopic count is also a perfectly good test, but it must be used by trained workers. The reductase test or microscopic count, along with the curd test and examinations by the senses, provide an adequate means of grading milk. These tests are not infallible, but they are correct in most cases. A milk graded second quality will always be definitely second grade; occasionally a second-grade milk will escape notice and be classed as first grade. This, however, will not often occur.

What may be expected of Milk-grading.

(1) Milk-grading ought to raise the average quality of our raw-milk supply, and give the factory-manager a chance of improving cheese quality.

(2) It should assist in uniformity of manufacture from day to day.

(3) It will improve cheese-flavour, under good conditions of manufacture.

(4) It will particularly improve the flavour of raw-milk cheese.

(5) It cannot be expected to eliminate cheese faults completely, because there are in milk some factors affecting quality that have to date been unidentified.

(6) It should considerably assist in raising average quality.

It is worthy of mention that milk-grading is practised widely in Denmark, and its adoption is being urged in Canada.

Methods of Manufacture in relation to Cheese Quality.

This is of more interest to cheese-factory managers than directors or suppliers. A considerable number of straight-forward practical experiments have been carried out. It has been shown that certain factors lower quality. These include (1) the incorporation of excessive moisture in cheese; (2) salting the curd before it is ready—in other words, hurrying the making process; (3) the use of excessive amounts of salt; (4) the lack of care in packing curd in hoops; (5) failure to recognize the relationship of moisture content to the rate of acid-development in curd; and (6) the use of inactive starters.

The experimental results have a direct bearing on factory policy. It is most inadvisable to aim at yield without unduly considering quality. Real quality will safeguard yield, because excessive dryness is as bad as excessive moisture. Suppliers must impose no time-limits on makers; cheese-making cannot be carried out according to a set time-table, and is at the best a lengthy process. The late delivery of milk at the factory involves either the hurrying of the process, with resulting danger of lowering quality, or alternatively the payment of overtime if cheese of good quality is aimed at.

Investigations during the past year show that some factories have been using excessive amounts of salt, resulting in a harsh body in the cheese. A well-made curd requires from 2 per cent. to 2¼ per cent. of its weight of salt. It is important to avoid extremes in either direction in the application of salt to cheese. When too small quantities are added, the body and flavour of the cheese are affected. Excessive salting, it should be carefully observed, is not the only cause of harshness.

I regret that under the best conditions of manufacture there are some difficulties for which no adequate solution can yet be offered.

Cheese Maturity.

Considerable attention has been devoted to the relation of maturity to cheese quality and to methods of improving the state of maturity of export cheese on arrival in Great Britain. The keeping of cheeses till they are mature has a most beneficial effect on flavour, body, and texture, *provided they are of good quality when made.* In an immature state cheese has an insipid flavour, which is sometimes described as metallic; the body is tough and curdy. As the cheese matures, the characteristic full Cheddar flavour develops and the body becomes smooth.

Our results show that the holding of cheeses till they are ripe exerts a considerable influence on slit openness. As the cheese matures the slits tend to close up. In a series of trials cheeses cut at sixty-five days old showed decided openness, whilst others from the same vats, kept till they were more mature, showed openness to a much lesser extent. There is an equally great difference in the cracking of the cut surfaces of immature and ripe cheeses after two days' exposure; an immature cheese opens up badly, even if the cheese is apparently close when cut, whilst a mature cheese opens up very slightly. The former loses more moisture than the latter on exposure to atmosphere.

It is important to observe that only clean-flavoured, well-made cheeses improve on keeping them till they are mature. If cheeses are carrying excessive moisture or are off in flavour when first made, their quality decreases with storage beyond the state of mild maturity. The Institute is meanwhile investigating the effect of several factors affecting the rate of development of maturity, with a view to obtaining some definite knowledge on the question which can be put into immediate practice. The principal questions under consideration are the effects of (*a*) keeping factory curing-rooms at a temperature in the vicinity of 60° F.; (*b*) keeping cheeses on the factory shelves for periods longer than the present standard of fourteen days; (*c*) holding cheeses for longer periods in grading stores before export; (*d*) the use of additional rennet; (*e*) variations in the quantity of salt applied to the curd; and (*f*) selected strains of starter organisms.

Altogether there are 360 cheeses in this trial which have to be examined individually. Several lots of cheese in the trial have yet to be examined, and the results are therefore not yet finalized. Close contact is being kept with the Dairy Board and Dairy Division so that the results can be utilized during the coming season. It may be of some interest to state that increased curing temperatures, the use of more rennet, and the use of reasonable quantities of salt are producing definite results. There is ample experience to recommend longer holding-time before shipment as a reliable cure for lack of maturity, but, on account of the expense of holding, other factors must be considered. Very low temperatures either in curing-rooms or aboard ship delay ripening. On the other hand, excessively high temperatures, particularly over 65° F., cause deterioration in cheese quality. Thus it is in the interests of factories to control the temperature of their curing-rooms. In this connection a great advance has been made in the shipping of our produce by the arrangement made by the Dairy Board with shipping companies to place thermographs in cheese-holds, so that all concerned will know definitely how temperatures in holds have behaved on the voyage to Britain.

The relationship of pasteurization of milk to the rate of maturing of cheese must not be overlooked. With high pasteurizing temperatures true Cheddar flavour does not develop. Milk should be pasteurized at temperatures as nearly as possible within the limits of 150° F.–155° F. Raw-milk cheese develops full Cheddar flavour earlier than pasteurized-milk cheese; but the milk quality must be good, otherwise really offensive flavours develop in the ripening process.

Attempts have been made at different times to get some knowledge of the age at which New Zealand cheese is mature when handled under present conditions. A batch of cheeses made in September–October, 1929, and exported in the usual way was not considered mature till they were approximately seven months old; another made in December, 1929, was six months old; a third made in February, 1930, was six months old; a fourth made in September, 1930, was six months old. It is reasonable, therefore, to conclude that under the present methods of handling produce cheese is six months old before it is mature. This age far exceeds that at which much spring-made cheese is marketed, which would appear to be less than three months in some cases.

Other Experimental Work on Cheese.

During the past dairying season cheese has been made from low-testing, high-testing, and standardized high-testing milks, produced on the same farm under identical conditions. A long series of investigations has also been commenced upon starters. These aim at (*a*) throwing some light on the reason for loss of vitality in starter mother cultures; (*b*) ascertaining the effect of starters on cheese-flavour; (*c*) using as starter cultures strains of organisms specially suitable for the production of acid and flavour; (*d*) developing a simple test by which the vitality of a starter can be judged without trying it out in a cheese-vat, so that ultimately the cheese-maker may daily select from a number of mother cultures the best for his purpose; (*e*) determining the effect of active and inactive starters on cheese quality; and (*f*) determining whether a large amount of a relatively inactive starter is as effective in cheese-making as a small amount of an active one.

This starter work is most important, because good milk and good starters are the foundation of good cheese. Some peculiar experiences have been encountered in the propagation of starter cultures in the research dairy factory. They are very sensitive to temperature and acidity changes, thus every factory should have proper facilities for preparing and caring for starters. Attention has also been devoted to the influence of pressure on cheese-texture and to factors affecting pressure. The cheeses made in the above experiments have not all yet been examined at maturity, and until the full series of experimental results are to hand no opinions can be safely expressed.

The Institute is collaborating with Mr. Morgan, of the Dairy Division, and with Mr. Veale, of the Hawera Laboratory, in regard to the cause of muddy, bleached, and pink discoloration. While no definite cause has yet been shown, it is evident, as Mr. Morgan has shown, that the trouble arises when cheese-rinds are cracked, and discoloration follows openings in the cheese.

Further Research Work necessary.

The gross effects of feed, top-dressing, machine-milking, and several phases of manufacture have yet to be tackled, but are not being overlooked.

The work of the Institute during the past three years has been directed towards a solution of some of the problems in the cheese industry by the introduction of some variations in the process of

manufacture. These studies have yielded some positive and definite results, which have been communicated in addresses to the National Dairy Association Conference at Hamilton and in the present discussions. The problems have also been clarified by the elimination of a number of suggested causes for deterioration in cheese quality. By the work carried out to date we are led to the conclusion that it is essential to carry out some fundamental studies of the changes taking place in the cheese-making process, simultaneously with the attempt to overcome present difficulties in a straight-forward, practical manner. The fundamental studies have already been begun, but the problem is so complex that no results are yet available for report. Investigations are already being made of the effect of abnormal milks and on the chemical changes that take place in the cheese making and curing process. The fundamental work is being assisted by a grant from the Empire Marketing Board. With continued moral and financial assistance from producers and factories, this work must in the long-run help the dairy industry.

Butter Experiments.

During the 1929–30 season experiments were carried out on the manufacture of butter from cream to which starter was added. The highest degree of acidity in the cream was 0·17 per cent. Both fresh cream and neutralized cream were used. The results showed that when the butter was graded in London at three months old the starter butter made from fresh cream scored highest in fifteen churnings, the fresh-cream butter in eight churnings, and the scores were equal in fourteen churnings. At this age there was a little in favour of the starter butters when fresh cream was used. When these butters were held in New Zealand for six months the starter butter scored highest in four churnings, the non-starter in five churnings, and they were equal in twenty-eight churnings. Thus after six months' storage period there was no material improvement from the use of starter. The butter made from neutralized cream scored differently. At three months old in London the starter butter scored highest in seven churnings, that without starter in six, and they were equal in twenty-four cases. After six months storage in New Zealand the starter butter was highest in three cases, the non-starter in three cases, and they were equal in thirty-one cases. Thus no advantage was derived from the addition of starter to neutralized cream.

In the season 1930–31 several lots of butter were made from cream in which much higher degrees of acidity were developed. These ranged from 0·20 to 0·46. The detailed results have not yet been received from England, but cabled advice indicates that some of the starter butters developed off-flavours and graded much lower than the fresh-cream butter. The results will be made public when available.

The Institute has had during the season the hearty co-operation of the Massey Agricultural College, the Department of Scientific and Industrial Research, the Dairy Division of the Department of Agriculture, the Dairy Board, and laboratories of the New Zealand Co-operative Dairy Company and the Taranaki Federation of Co-operative Dairy Factories—to all of whom thanks are expressed.

EFFECT OF RUSTS AND MILDEW ON YIELD AND QUALITY OF WHEAT.

J. C. Neill, Field Mycologist, Plant Research Station, Palmerston North.

Though it has always been generally accepted that the diseases known as rusts and mildew detrimentally affected the yield and quality of wheat, it is only recently that a method has become available to measure this effect. Canadian and American workers have demonstrated that these diseases can be almost completely controlled by dusting the growing plants with sulphur; consequently, it is possible in the same field to have plots of wheat dusted and so kept relatively free from rusts and mildew, and comparative plots of the same wheat undusted, and so subject to the normal local infection.

The object of the experiment here recorded was not to demonstrate the commercial possibility of sulphur dusting of wheat, but to obtain a measure of the actual loss caused by these diseases under conditions favourable to their maximum attack.

Experimental Method.

Plots 29 ft. long of five rows 1 ft. apart were sown at the Plant Research Station, Palmerston North, in August, 1930, with certified seed of eight of the main varieties of wheat grown in New Zealand. These plots were transversely divided in half by cloth screens, one half of each plot being thoroughly dusted at weekly intervals with Alpha sublimed sulphur. The first dusting was done on November 15th, no rust sori having yet appeared on the plants. Two hours later heavy rain set in and continued for twenty hours, washing most of the dust from the foliage. The dusting was repeated on 18th November, and again on the 25th, when a trace of leaf-rust (*P. Elymi*) and mildew was detected on both the dusted and undusted plots. The plots were again dusted on December 2nd, 9th, 19th, and 27th, and on January 2nd, 9th, 15th, 23rd, and 30th. The plots were harvested on various dates from February 2nd to 19th, according to ripeness of the varieties. The dusting was always carried out from 5 to 6 a.m.—that period of the day being most suitable owing to the absence of wind and to the damp condition of the foliage.

The weather was exceedingly broken during this period—rain falling on eleven days in December and twenty days in January—and there was an almost constant succession of high winds with low average temperature.

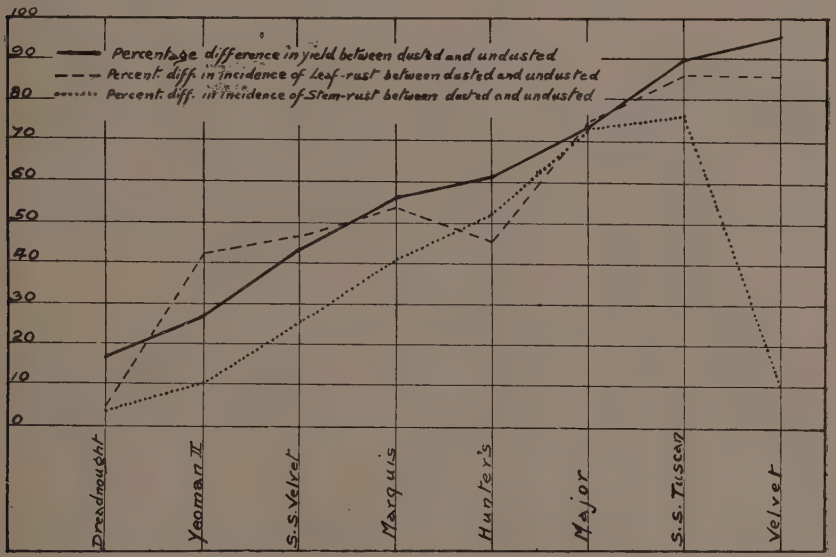
Following cutting, the sheaves were stooked in the field for a week or ten days, and then all the sheaves from each plot were cut and mixed in an even layer on a barn floor. From this was taken at random ten lots of 100 stems, the heads from which were rubbed out, the grain cleaned from chaff, &c., and then weighed. The figures given for incidence of the rusts are estimations based on notes taken during growth and after harvesting. The results are given in the accompanying table and graph.

Notes on Results.

The sulphur-dusted halves of the plots outyielded the undusted halves by from 17 per cent. to 96 per cent., the amount of the increase

Results of Dusting Wheat Varieties with Sulphur at the Plant Research Station, Palmerston North, Season 1930–31

Variety.	Mean Weight of Grain in Grammes per 100 Heads.			Mean Number of Grains per Gramme Weight.		Mean Number of Grains per Head.		Percentage of Increase in Yield of Dusted over Undusted Plants.	Estimated Incidence of Rusts expressed as Percentages.			
									Leaf-rust (*P. Elymi*).		Stem-rust (*P. graminis*).	
	Dusted.	Undusted.	Difference.	Dusted.	Undusted.	Dusted.	Undusted.		Dusted.	Undusted.	Dusted.	Undusted.
Dreadnought	181·9±1·56	155·5±2·76	26·4±3·01	17·9	19·8	32·6	30·7	17	0	5	0	3
Yeoman II ..	149·3±1·57	117·6±0·96	31·7±1·79	24·6	29·6	36·6	34·8	27	3	45	0	10
Solid-straw velvet	192·6±2·51	135·1±1·70	57·5±2·99	25·6	32·3	45·5	43·6	43	3	50	3	30
Marquis ..	143·2±1·95	91·0±2·27	52·2±2·98	25·7	28·4	36·8	25·9	57	7	60	4	45
Hunter's ..	122·5±1·78	76·2±1·82	46·3±2·55	27·7	36·5	33·9	27·8	61	9	55	3	55
Major ..	206·5±2·28	118·6±2·07	87·9±3·07	20·5	31·0	42·4	36·8	74	10	85	2	76
Solid-straw Tuscan	181·2±0·92	95·5±3·11	85·7±2·82	21·1	35·0	38·3	33·4	90	8	95	3	80
Velvet	162·9±1·59	83·0±1·51	79·9±2·19	26·1	39·8	42·6	33·0	96	9	95	2	12



being directly correlated with the relative severity of rust attack in all varieties with the exception of Velvet.

Mildew was present to some extent in all the undusted lots, Major, Solid-straw Tuscan, and Velvet (particularly the latter) being the most severely affected. The dusted plots showed only a trace.

The increased yield of the dusted plants was chiefly due to the greater weight of the individual grains, and only to a much lesser extent to an increase in the number of grains per head.

NITROGEN TOP-DRESSING OF WHEAT.

EXPERIMENTS WITH VARIOUS FORMS OF FERTILIZER AT DIFFERENT TIMES OF APPLICATION, SEASON 1930–31.

W. C. STAFFORD, Instructor in Agriculture, Christchurch; T. A. SELLWOOD, Instructor in Agriculture, Oamaru; K. M. MONTGOMERY, Fields Instructor, Timaru.

THE results of an experiment on similar lines to those reported below were published in this *Journal* for March last. As indicated in the previous report, these trials form part of a comprehensive series of wheat-manuring experiments being conducted in the main wheat-growing areas of the South Island. The objects of the investigation under review were discussed in the previous report. Particulars of the 1930–31 trials are as follows:—

(1) Experiment on Farm of F. W. Carpenter, Prebbleton, Canterbury.

(Conducted on same farm as experiment recorded in *Journal*, March, 1931.)

Soil: Fine sandy loam overlying shingle subsoil. Variety of wheat and seeding: Solid-straw Tuscan at 112 lb. per acre. Previous crops: 1929–30, potatoes; in grass for three previous seasons. Date sown: 30th June and 1st July, 1930. Date harvested: 3rd February, 1931.

MANURING.

All plots received a basal dressing of superphosphate (44–46 per cent. tricalcic phosphate) at 1½ cwt. per acre, drilled in with the seed. The nitrogen treatments shown below were applied on different plots on 27th August, 23rd September, and 3rd November respectively. The intention had been to make application on or near the 20th of August, September, and October, but windy weather caused delay. Nitrogen treatments per acre were as follows:—

(1) No nitrogen (super only).	
(2) Nitrate of soda (15·5 per cent. N.)	149 lb.
(3) Sulphate of ammonia (20·6 per cent. N.) ..	112 lb.
(4) Calcium cyanamide (19 per cent. N.)	121 lb.
(5) Urea (46 per cent. N.)	50·5 lb.
(6) Calnitro (20·6 per cent. N.)	112 lb.

Each fertilizer treatment supplied approximately 23 lb. of nitrogen per acre.

The plots were arranged exactly as in the previous season's experiment on this farm (see *Journal*, March, 1931), there being eighteen replications of each of the treatments shown above for each date of application of nitrogen, giving in all 324 plots.

Nitrogeneous manures were applied by hand, being mixed with sawdust to provide sufficient bulk of material to facilitate even distribution. The same method was adopted in Experiments 2 and 3 below, except that beach sand was used in Experiment 2.

OBSERVATIONS DURING GROWTH OF CROP.

27th August: The first application of nitrogen was made on this date, approximately eight weeks after sowing. The crop was about 2½ in. high, and light green in colour.

23rd September: On this date the second application of nitrogen was made, approximately twelve weeks after sowing, the crop being about 4 in. in height. On this date there was no visible effect from the applications made in August.

3rd November: The third application, which was made on this date, was inadvertently delayed on account of a prolonged spell of windy weather. The crop was about 6 in. in height. The plots treated with nitrogen in August and September were conspicuous by their deeper green colour, better growth, greater tillering; the plots untreated with nitrogen were rather a light green colour. The nitrate-of-soda plots were the best grown, being slightly taller and broader in the leaf than plots treated with other forms of nitrogen, which were very similar, except the plots receiving calcium cyanamide, which were not such a deep green nor quite so well grown as the others.

15th November: On this date the effect of the application of nitrogen made on 3rd November were discernible, all being slightly darker in colour than the no-nitrogen plots except calcium cyanamide, which had caused a decided yellowing of the plants. This undesirable effect is reflected in the yields shown below, and at harvesting the cyanamide plots dressed in November were poorer than the no-nitrogen plots.

3rd February: The crop was harvested on this date. The no-nitrogen (super alone) plots were slightly later in ripening than the plots treated with nitrogen. All nitrogen plots, except those receiving calcium cyanamide on 3rd November, appeared superior to the no-nitrogen plots, although not to the extent indicated earlier, there being many unfilled heads.

Weather and rainfall conditions, which are discussed later, were not at all favourable during the few weeks preceding harvest.

YIELDS.

The yields for the 1930–31 crop are given in Table 1, and in order that a comparison between the nitrogen responses in 1930–31 can be made with those from the 1929–30 crop the latter, as published in the *Journal* for March, 1931, are shown in Table 2.

Table I.—Summary of Yields in Experiment on Farm of F. W. Carpenter, 1930–31.
(Each yield is the average of eighteen plots.)

Treatment.	Yields in Bushels per Acre.		
	Application of Nitrogen made 27th August.	Application of Nitrogen made 23rd September.	Application of Nitrogen made 3rd November.
No nitrogen (super only) ..	39·1	39·2	39·2
Nitrate of soda, 149 lb. ..	45·3 (6·2)	45·4 (6·2)	43·2 (4·0)
Sulphate of ammonia, 112 lb. ..	42·5 (3·4)	42·8 (3·6)	40·9 (1·7)
Urea, 50·5 lb.	44·2 (5·1)	41·9 (2·7)	41·5 (2·3)
Calcium cyanamide, 121 lb. ..	44·1 (5·0)	42·9 (3·7)	36·7 (—2·5)
Calnitro, 112 lb.	44·1 (5·0)	40·4 (1·2)	42·9 (3·7)

Figures in brackets are the differences between the yields of the nitrogen treatments and the corresponding no-nitrogen treatments at the top of the column. (This applies to all yield tables.) All are increases, except one, which is indicated by a minus sign.

The standard error is 1·06 bushels, so that any differences between treatments greater than 3·2 bushels per acre (three times the standard error) are statistically significant, and may be accepted with confidence. The very close agreement in the average yields of the three lots of no-nitrogen plots points to a higher degree of precision than is indicated by the standard error.

NOTE.—Statistical examination of the results of all three experiments conducted in 1931 and described in this article was made by the method of Fisher and Wishart, Technical Communication No. 10, Imperial Bureau of Soil Science. It should be noted, however, that treatments were arranged in systematic order and not randomized in blocks.

Table 2.—Summary of Yields in Experiment on Farm of F. W. Carpenter, 1929–30.
(Each yield is the average of eighteen plots.)

Treatment.	Yields in Bushels per Acre.		
	Application of Nitrogen made 19th August.	Application of Nitrogen made 21st September.	Application of Nitrogen made 19th October.
No nitrogen (super only) ..	37·8	37·9	38·1
Nitrate of soda, 149 lb. ..	46·3 (8·5)	48·7 (10·8)	48·8 (10·7)
Sulphate of ammonia, 112 lb. ..	47·1 (9·3)	45·3 (7·4)	43·6 (5·5)
Urea, 50·5 lb.	46·4 (8·6)	45·2 (7·3)	42·7 (4·6)
Calcium cyanamide, 121 lb. ..	45·4 (7·6)	39·7 (1·8)	41·4 (3·3)
Calnitro, 112 lb.	44·4 (6·6)	44·8 (6·9)	43·7 (5·6)

CONCLUSIONS FROM TABLES 1 AND 2.

(1) Every nitrogen treatment caused a greater increase in 1929–30 than in 1930–31 season, except the September application of calcium cyanamide. The lesser response to nitrogen in the latter season is most likely due to the adverse conditions for a few weeks before harvesting. In the 1930–31 season nitrogen dressings were less effective than usual, as was indicated in the report published in the *Journal* for May, 1931.

(2) In each of the seasons nitrate of soda at its most suitable time of application has caused greater increases than any of the other forms of nitrogen at their best. The comparatively poor results from sulphate of ammonia in the 1930–31 season are of interest, but no explanation can be offered for its behaviour.

(3) From the evidence provided by these two trials it appears that the best of those times investigated for the application of the various forms of nitrogen varies according to the form of nitrogen and the season. It must be understood that the remarks on the most suitable times to apply different forms of nitrogen are tentative and subject to modification in the light of further work. In the absence of more definite knowledge, the recommendations for current practices must be based on information available, even though such

information is limited. Further, the remarks must be taken to apply only to the district in which the experiments were conducted, but it is reasonable to suppose that they should apply equally well to other districts having somewhat similar conditions of climate and time of harvesting where autumn or early winter sown wheat are concerned.

(4) About 20th September appears to be the best time for application of nitrate of soda. With the other forms of nitrogen the results suggest that application should be made not later than 20th August. Earlier application may be advantageous, but until this is put under trial no statement can be made on the point.

Rainfall and Weather Conditions.

The local rainfall from May to January inclusive for the two seasons under discussion is shown in the following table :—

Table 3.—Showing Monthly Rainfall for Period May to January, inclusive.

Month.	1929–30.		1930–31.	
	Rainfall.	Number of Days on which Rain fell.	Rainfall.	Number of Days on which Rain fell.
	Inches.		Inches.	
May, 1930	0·61	6	2·04	11
June	4·32	11	1·31	12
July	3·58	17	2·93	20
August	1·44	7	3·64	12
September	1·67	11	2·24	14
October	0·13	4	1·01	16
November	0·91	8	1·18	9
December	3·89	15	1·79	9
January, 1931	5·10	16	0·99	11

The months of December and January in the 1930–31 season were marked by a long-continued series of dry north-west winds, which caused wheat crops in general to become rather shrivelled in the head, the normal process of ripening being considerably affected. These conditions obviously militated against the response to nitrogenous manures.

(2) Experiment on Farm of C. M. Talbot, Tycho, South Canterbury.

Soil : Medium clay loam with stiff clay subsoil. Variety of wheat and seeding : Solid-straw Tuscan, 123 lb. per acre. Previous crop : Grass for three years. Date sown : 15th May, 1930.

Manuring.

All plots received a basal dressing of 1 cwt. of superphosphate per acre, drilled in with the seed. The nitrogenous fertilizers were applied to different plots as follows, the amounts being per acre :—

(1) No nitrogen (superphosphate only).
(2) Nitrate of soda, 149 lb. } applied 20th August.
(3) Sulphate of ammonia, 112 lb. }

(4) Nitrate of soda, 149 lb.
(5) Sulphate of ammonia, 112 lb. } applied 20th September.
(6) Nitrate of soda, 149 lb.
(7) Sulphate of ammonia, 112 lb. } applied 20th October.

The above series of plots were replicated twelve times. Six replications ran on each side of a middle plot, being arranged in the order 1 to 7 from the middle outwards. Each plot was 2 chains long and seven coulter rows wide, with 14 in. between plots.

Observations during Growth of Crop.

20th August: The first application of nitrogen was made, the crop being about 4 in. in height.

20th September: The second application of nitrogen was made, the crop being about 5 in. high and tending to be rather yellow. The August applications showed only a very slight effect on growth and colour at this date.

20th October: The third application of nitrogen was made. The crop was about 9 in. high and looking exceedingly well. The effect of the August and September dressings of nitrogen were not very pronounced. The nitrate of soda applied in September was the best plot in colour and growth. The August and September applications of sulphate of ammonia were very similar in effect, and looked slightly better than the August nitrate of soda.

17th February: The crop was harvested on this date. The plots receiving sulphate of ammonia in August, and those receiving nitrate of soda in September appeared the best. The October dressing of nitrate of soda appeared to have a better effect than the sulphate of ammonia applied in September and October. The August application of nitrate of soda looked no better than "no nitrogen." The yields are shown in the following table:—

Table 4.—Yields in Experiment on Farm of C. M. Talbot, 1930–31.

(Each yield is the average of twelve plots.)

Treatment.	Yields in Bushels per Acre.		
	Application of Nitrogen made 20th August.	Application of Nitrogen made 20th September.	Application of Nitrogen made 20th October.
No nitrogen (super only) ..	50·3	..	..
Nitrate of soda, 149 lb. ..	52·1 (1·8)	55·3 (5·0)	55·7 (5·4)
Sulphate of ammonia, 112 lb. ..	53·1 (2·8)	53·8 (3·5)	52·9 (2·6)

Standard error = 0·47 bushels per acre. Difference greater than 1·4 bushels per acre (three times standard error) are accepted as significant.

Comments on Table 4.

(1) All applications of nitrogen have caused significant increases in yield. The highest response is that from nitrate of soda applied in October, amounting to 5·4 bushels per acre. In the two previous seasons nitrate of soda at ½ *cwt.* per acre as an addition to super was used on the adjoining farm of P. R. Talbot. In 1928 the

nitrate of soda was applied on 29th September and in 1929 on 25th September. The increases in yield were 5·5 and 5·7 bushels per acre for the first and second seasons respectively. It must be remembered that in the 1930–31 season 149 lb. of nitrate of soda were used as against 112 lb. in the two previous seasons. While admitting the possibility of soil-differences, the results certainly indicate that the 1930–31 season was less favourable to responses from nitrogenous manures.

(2) The yields increase with lateness of application in the case of nitrate of soda, although no significance is attached to the difference between the September and October application. The response from the September and October applications of nitrate of soda have proved significantly better than the responses from any of the sulphate of ammonia applications.

(3) Although there are no significant differences between the increases from the various dressings of sulphate of ammonia, the figures probably indicate their relative merits fairly closely, and the September dressing has proved the best.

Rainfall and Weather Conditions.

The rainfall records shown in Table 5 are those taken at Timaru, which is about nine miles from the site of the experiment.

Table 5.—Monthly Rainfall for Period May to February, inclusive, 1930–31.

Month.	Rainfall.	Number of days on which Rain fell.	Month.	Rainfall.	Number of Days on which Rain fell.
	Inches.			Inches.	
May, 1930 ..	1·20	9	October, 1930 ..	1·44	13
June	0·64	7	November ..	1·50	12
July	0·64	9	December ..	0·96	9
August.. ..	3·00	11	January, 1931 ..	1·78	11
September ..	2·02	14	February ..	2·24	7

During August and September the land was too wet to allow the use of a drill for top-dressing. The spring and early summer were very cold, October, 1930, being the coldest October on record. Good growing weather prevailed during November and December. A series of hot north-west winds lasting nearly three weeks, in January, caused rapid drying-off, with the result that the grain was slightly pinched.

(3) Experiment on Farm of J. R. McCulloch, Ngapara, North Otago.

Soil: Fairly heavy clay loam, with clay subsoil. Variety of wheat and seeding: Velvet, 90 lb. per acre. Previous crops: 1927–28, wheat; 1928–29, oats; 1929–30, rape. Date sown: 27th May, 1930. Manuring: Treatments, quantities, and date of application were as for the preceding Experiment 2, except for date of applying super with seed.

Arrangement of plots and replications: The size and arrangement of plots were as for Experiment 2, but the number of replications was ten in this case.

Observations during Growth of Crop.

20th August: When the first application of nitrogen was made on this date the plants were about 3 in. high.

20th September: The plants were about 4 in. high on this date, when the second application of nitrogen was made. The plots treated with nitrogen in August were of a slightly darker green colour than the remainder, but there was no appreciable difference in growth.

20th October: The final application of nitrogen was made, the crop being about 6 in. in height. The previous applications of nitrogen were showing quite markedly, the dressed plots being better grown and darker than plots which had not received nitrogen. There was very little difference between plots receiving the different nitrogenous manures. August and September treated plots were very similar in appearance.

5th February: The crop was harvested on this date. The no-nitrogen plots were ripest, but the nitrogen-treated plots were considered fit enough for harvesting, and any delay would have entailed the risk of loss through shaking. The August and October treated nitrogen plots were slightly riper than those dressed in September. The delay in ripening due to nitrogen is of interest. In Canterbury nitrogen almost invariably hastens final maturity, although ear-emergence is delayed a little.

The yields are shown in the next table:—

Table 6.—Yields in Experiment on Farm of J. R. McCulloch.

(Each yield is the average of ten plots.)

Treatment.	Yields in Bushels per Acre.		
	Application of Nitrogen made 20th August.	Application of Nitrogen made 20th September.	Application of Nitrogen made 20th October.
No nitrogen (super only) ..	29·5	..	..
Nitrate of soda, 149 lb. ..	33·1 (3·6)	33·0 (3·5)	34·5 (5·0)
Sulphate of ammonia, 112 lb. ..	31·5 (2·0)	32·2 (2·7)	32·0 (2·5)

Standard error = 0·54 bushels per acre. Differences greater than 1·6 bushels per acre are accepted as significant.

Comments on Table 6.

(1) All applications of nitrogen have resulted in significant increases in yield, the October application of nitrate of soda being the most effective, and significantly better than all applications of sulphate of ammonia.

(2) The differences between the yields of the sulphate-of-ammonia plots are not significant, but indicate a slight superiority of the September application over the August and October ones.

(3) So far as this one experiment is a guide for this district, October appears to be the most suitable time to apply nitrate of soda and September the most suitable for sulphate of ammonia.

Rainfall and Weather Conditions.

The rainfall records are those for Ngapara, the locality of the experiment, as follows :—

Table 7.—Monthly Rainfall from May to February, inclusive, 1930–31.

Month.	Rainfall.	Month.	Rainfall.
	Inches.		Inches.
May, 1930	0·99	October	1·42
June	0·40	November	1·78
July	0·60	December	1·13
August	2·65	January, 1931 ..	2·52
September	2·73	February	2·05

The spring and early summer were cold, and growth was backward as a result. The season could not be regarded as a particularly favourable one.

General Remarks.

It has been decided not to attempt an evaluation of the increases from the use of the nitrogenous fertilizers used in these trials at the present juncture, as this will be more effectively carried out, so far as nitrate of soda and sulphate of ammonia are concerned, in connection with reports on the general series of experiments. The weather conditions in the 1930–31 period appear to have been unfavourable for good responses to nitrogenous fertilizers.

The trials are being repeated in the season of 1931–32, with some slight modifications, and in a year or two it should be possible to give some really reliable guide as to the best time at which to apply different forms of nitrogen to autumn- and winter-sown wheat. For the present one must be guided by the results already obtained, even though some modification of the recommendations may be necessary in the light of greater knowledge.

An experiment similar to Nos. 2 and 3 here recorded was laid down by Mr. E. M. Bates, Instructor in Agriculture, Ashburton, but owing to lodging of the crop it could not be harvested satisfactorily.

Summary.

(1) Three experiments have been described in which equal quantities of nitrogen, in nitrate of soda (149 lb. per acre) and sulphate of ammonia (112 lb.), were applied in August, September, and October (and November in one case) to different plots of wheat sown in May and June with superphosphate drilled in with the seed.

(2) In one of these experiments Urea, calcium cyanamide, and Calnitro were also used under the same conditions and in quantities supplying the same amount of nitrogen as 1 cwt. of sulphate of ammonia. The results of an exactly similar experiment for the previour year are also given. The highest yields were obtained from nitrate of soda in both years ; in the 1929–30 season September and October proved equally the best months in which to apply nitrate of soda ; in 1930–31 August and September gave the best and equal increases. Sulphate of ammonia gave its best results in 1929–30,

when applied in August; in 1930–31 August and September applications gave almost equal increases, which were decidedly better than that from November application. Urea gave its greatest increase from the August application in both seasons. Calcium cyanamide did likewise; in 1930–31 the yield was depressed by the October application, which caused bad yellowing of the foliage. Calnitro gave its best results in September of the 1929–30 season, but this application was only slightly better than the August one; in 1930–31 best results were obtained from it as a result of applying in August.

(3) The best increases from nitrate of soda were better than the best increases from sulphate of ammonia in all trials.

(4) In South Canterbury October application of nitrate of soda proved slightly better than September application, both being decidedly superior to the August application. Sulphate of ammonia gave its best increase from the September application in South Canterbury.

(5) In North Otago October proved to be the best month in which to apply nitrate of soda. The September application of sulphate of ammonia was slightly better than the August and October ones. In this trial the nitrogenous fertilizers delayed ripening slightly. This is contrary to the usual experience in Canterbury, where application of nitrate of soda made as late as October usually hasten ripening, although ear-emergence is delayed by it.

(6) The effect of climatic conditions are discussed briefly; monthly rainfall records for each of the districts in which trials were conducted are given.

The assistance given by the farmers mentioned in providing land and assisting in the reaping of the trials is duly acknowledged. To our fellow-officers who assisted with the experiments our thanks are also due.

USE OF SUPERPHOSPATE IN STABLES.

Overseas authorities have recently recommended superphosphate as an absorbent, deodorant, and conserver of nitrogen in stables. The scattering of super in the stalls and gutters of horse-stables and cow-sheds has for its objects the removal of objectionable odours and the absorption and fixing of ammonia in the manure. Any one accustomed to enter a horse-stable in the early morning is familiar with the pungent odour which assails his nostrils — proof that valuable ammonia is being lost by volatilization.

The use of superphosphate for the purpose mentioned is very rational, as this particular fertilizer contains a considerable proportion of gypsum (hydrated sulphate of lime). It is a well-known agricultural fact that gypsum in a finely divided state is specially adapted as a preservative agent of the fertilizing principles of farmyard manure.

Superphosphate should not only prevent the loss of ammonia but also add phosphoric acid plant-food, in which farmyard manure is somewhat deficient. The ammoniation of superphosphate is a process recently introduced by the fertilizer industry, whereby ammonia liquor is added to and absorbed by superphosphate, which fixes the ammonia (or nitrogen) in a chemical compound. The same principle is held to apply to the use of superphosphate as an ammonia absorbent in stables.

—J. A. Bruce, Inspector of Fertilizers.

THE LEG-LOUSE OF SHEEP AND ITS CONTROL.

R. WRIGHT, Principal Inspector, Live-stock Division, Wellington.

THE leg species of sheep-louse (*Hæmatopinus pedalis*) was first reported in New Zealand from Banks Peninsula, Canterbury, in 1911. Since that time and for several years leg-lice were seldom reported, and it is safe to assume that the infestation of sheep with them was very limited. More recently, however, they have come under notice on many farms in many widely divergent localities throughout the Dominion, and are evidently on the increase.

Generally this parasite confines itself to the hairy parts of the leg and scrotum of the animal, but cases have recently come under notice where the whole of the belly-wool has been densely infested. Owing to the large number of eggs deposited by this louse, giving the legs and adjacent wool-locks a distinctive brown appearance, its presence is readily detected, particularly when the flock is being handled for shearing or crutching. Ordinary dipping methods are effective in dealing with this louse, but it must be borne in mind that a second dipping in eight or ten days' time is necessary to destroy any lice that may have hatched out from eggs not destroyed by the first dipping. It is, of course, possible for a clean sheep to become affected from an infested one, and this is the usual method of spread, but, owing to the louse being a blood-sucking and not an active biting one, it moves about little, and as a rule only a small proportion of the flock becomes affected—at any rate, to a noticeable extent.

The leg-louse is quite distinct from the ordinary biting sheep-louse (*Trichodectes sphærocephalus*), which latter is an extremely active and vicious little pest that causes intense irritation to sheep with loss of condition and vitality, and that can spread through the flock with alarming rapidity, as every experienced sheep-farmer knows. Leg-lice, which are generally found massed together in large numbers on the hairy parts of the leg and scrotum and on the edges of the wool-tufts adjoining, cause little irritation to the animal, and their presence is not considered of very serious account, the affected sheep generally appearing to be little inconvenienced, although the parasite is a blood-sucking one. As already indicated, the leg-louse is easily destroyed, and has been kept more or less in check by the ordinary dipping carried out for the control of other vermin. Under ordinary conditions it does not live more than a few days when separated from its host.

With the object of ascertaining the extent of infestation by the leg-louse, a questionnaire was recently sent out by the District Office, Wellington, and its presence was reported in seventeen out of twenty widely separated districts in which the inquiry was made. Farmers are advised to keep a sharp lookout for it when handling their sheep for crutching or shearing operations, and where it is found steps should be taken to eradicate it. When dipping is not possible or convenient, washing the legs and belly of the sheep with a poisonous sheep-dip mixture at ordinary dipping strength is advised. This should be repeated after an interval of eight or ten days to ensure the destruction of any lice hatched out in the interval.

THE BLEDISLOE FRUIT CHALLENGE CUP.

This handsome silver cup, which stands 2 ft. in height above its plinth, has been presented by Lord Bledisloe for the best exhibit of New Zealand apples competing in the Southern Hemisphere Section of the Imperial Fruit Show held in England in June.

The winner of the cup this year is Mr. H. E. Stephens, "Woodstock," Stoke, Nelson, with an exhibit of Jonathan apples. The cup is to be held by winners for one year, shields being provided on the plinth for their respective names.

SEASONAL NOTES.

THE FARM.

Aspects of Sward Improvement.

FARMERS generally should now be planning the grassland work for the coming year. In such planning it is often difficult to decide what should be done in regard to pastures which are too open, or on which the composition of the sward has deteriorated unduly because of bad treatment.

The use of fertilizers on such pastures suggests itself immediately to some, but there are definite limitations to the sound use of fertilizers in such a connection. Fertilizers have at times given almost magical effects in increasing the proportion of herbage from good species in a pasture—one or two dressings of phosphates have on many occasions brought clover, rye-grass, cocksfoot, and dogstail into prominence in swards in which these species, prior to the top-dressing, were faring so poorly that it was easy to overlook their presence. But that the species named were really in the sward, though faring poorly, is the point of moment; without them there would be no worth-while basis upon which to build up a sward by top-dressing.

When a worn-out pasture is so deficient in desirable pasture plants as to render quite ineffective the ordinary methods of improvement, such as top-dressing and harrowing, then, as a rule, the obvious and standard course is to plough and reseed, usually after a course of cropping which has tended to increase rather than to decrease soil fertility.

But in certain circumstances the standard course may not be practicable because of labour or cost considerations, or because of the nature of the land, which may be hilly or unduly sandy, or both. When this is the case the alternative course is to renovate the pasture by surface-sowing. Under average conditions autumn is as a rule the best time to attempt improvement by this means. It is well to remember that surface-sowing is attended by risks, and is not always successful, and, in respect to any future improvement that is being planned now, it should be kept in mind that the ploughed and cultivated surface is the most certain and speedy way to an improved sward. Hence, if at all practicable, it should be adopted. There has probably been at times too great an inclination to effect sward-improvement by slower and sometimes uncertain means such as top-dressing and surface-sowing. The advisability of improving worn-out pastures by ploughing and reseeding has been greatly intensified by the advent of reliable supplies of superior and lasting strains of species such as rye-grass.

The giving of due consideration to the matters just mentioned may advantageously lead at times to inferior pastures being broken up during the coming few weeks in order that they may be put under spring crops, as a first step towards eventual reseeding and production of a good sward on which expenditure on manures, &c., may much more satisfactorily be made than would have been the case had the inferior sward been persisted with.

Grass-harrowing.

Grass-harrowing very generally calls for attention during the July–August period, and frequently at this stage it should be severe enough not only to spread droppings which have accumulated during winter grazing, but also to exert a cultivating effect which may usefully strengthen desirable plants that hitherto have been relatively puny. At times the

opening-up of matted turfs, the injury of inferior species, and the provision of footholds for the establishment of better species are features of the general beneficial effect of drastic harrowing. From this it follows that the most striking effects from drastic harrowing may be expected from swards which have deteriorated because of bad management.

Care in Winter Grazing.

Young pastures, and particularly those in which permanency is desired, should be treated with special care at this season. "Poaching" or "pugging" is an obvious danger which leads to bare patches by means of which weeds gain access. Sheep, if they are not allowed to graze too closely, will, in comparison with cattle, lessen the danger of pugging. Injurious poaching, due to stocking ground when it is too wet and soft to carry stock, is by no means confined to young pastures, and is at times a primary cause of the sudden and wholesale appearance of such weeds as docks, buttercups, daisies, and thistles.

In trying to avoid poaching of young pastures one may be led into another fault—undergrazing. This will readily bring about weakening of valuable species such as clovers and crested dogstail. Young permanent pastures containing a considerable proportion of Italian rye-grass are particularly prone to suffer from undergrazing, because of the shading effect of the rye-grass on the more slowly developing species. The other extreme—overgrazing of young pastures—is in August the more prevalent fault, and may lead to a set-back to valuable species from which they will not readily recover.

Winter Top-dressing.

Much useful top-dressing of pastures has been done in the winter. Hence a farmer who has not already top-dressed may at this stage do it with every confidence that he will get good results. Under certain circumstances during July and August sulphate of ammonia or analagous nitrogenous manures may be resorted to with profit as a means of obtaining additional late winter or early spring feed. As a rule, it is inadvisable to apply nitrogenous fertilizer alone, except on pastures which during the past few months have been top-dressed with phosphates and possibly also with lime, while there are a few areas on which the use of potash also would have to precede maximum results from the ammonia.

If phosphatic top-dressing has not been done, say, in the autumn or early winter, and it is decided to use nitrogenous top-dressing, then the nitrogenous material should be applied only in conjunction with a phosphate. This may be done by using ammoniated superphosphate or a straight nitrogenous manure mixed with a phosphate. In this connection it is necessary to remember that the mixing of sulphate of ammonia with basic slag is not desirable, because it would bring about loss of ammonia, the valuable portion of the sulphate of ammonia.

For nitrogenous dressings at this season well-drained pastures in which perennial rye-grass is prominent should be selected if available. Before the application of the fertilizer, coarse dry herbage should be removed by suitable grazing, and generally the pasture should be harrowed just before or after the top-dressing. In brief, at this season nitrogenous top-dressing, provided it is suitably linked with the application of other fertilizers, is distinctly promising as an emergency means which on occasions could be employed with profit to augment scant supplies of winter and early spring feed.

Winter Utilization of Crops.

Some general matters regarding winter utilization of crops for stock were dealt with in these notes last month. These matters are still of current moment.

A point sometimes overlooked is that winter rations require to be suitable not only in quantity, but also in quality. It is not enough to provide merely something which will fill the stomach — the required amount of nutriment must also be present. The feeding of roots alone as a ration illustrates the position. It means too much watery bulky material in the animal's diet. To force stock to sustain themselves on roots alone is very analagous to what feeding human beings on ice-cream alone would be. Poor nutrition would occur in each case, irrespective of the amount of material consumed. A contrasting diet is that provided by straw or poor hay—bulky, dry, and indigestible—whereas the roots are bulky, succulent, and digestible. While it is mainly the bulkiness of the roots which detracts from them as an exclusive ration, the straw or poor hay fails on account of both bulkiness and indigestibility.

A ration containing roots may be balanced satisfactorily by the use of good hay, but poor hay or straw may call for the use of grain or other concentrates to give good results. Since it is so often practicable for farmers to resort to ensilage as a means of avoiding the production of poor hay, there is seldom any real reason why farmers should call upon their stock to consume poor, woody, weather-beaten hay.

In the feeding of silage to sheep 2 lb. to 3 lb. per head daily may be looked upon as a substantial contribution to the animal's ration for the purpose of supplementing a scant supply of fresh grass; while if sheep are to be maintained on silage alone, which is unlikely, the silage should be supplied at the rate of 5 lb. daily. This latter figure is interesting because it indicates that by providing a ton of grass silage one provides keep for, say, five ewes for three months. As an acre of reasonably good pasture-growth will yield from 5 to 7 tons of silage, it is clear that surplus summer grass converted into silage for winter feeding will quite substantially increase the carrying-capacity during the critical three months which over wide areas occurs from July to September. For instance, on the above figures 20 acres of surplus grass put in reserve as silage would enable from 500 to 700 extra ewes to be properly fed from the beginning of July to the end of September.

In feeding silage to cows it is well to make a start by distributing a relatively small amount—say, 2 lb. to 3 lb. per head daily. It will be possible to increase this quantity as the animals get used to the material. The quantity fed should be governed by the amount necessary to make good the shortage of grass. There is seldom occasion to exceed 30 lb. or 40 lb. daily.

If any pastures are showing signs of grass-grub infestation, but are not so seriously injured as to be beyond repair, then during the next few weeks the feeding of hay, silage, and roots may often with advantage be concentrated on those fields. At this stage the grubs, which for some time previously have mostly been located at considerable depths, return to near the surface, where they are more subject to injury from trampling by stock. Further, the trampling and the extra fertility induced by the feeding-out seem to be of value in assisting injured plants on which remnants of roots remain to recover more readily. On pastures which have been made open by the ravages of the grub, the feeding of hay made from overmature herbage is at times particularly useful, for such hay often contains viable seeds of valuable species, and the surface-sowing of such seeds resulting from the feeding of the hay materially strengthens the sward.

In the feeding of swedes, &c., attacked by club-root, consideration should be given to the danger of spreading the disease to land on which it may be desired to grow such crops in the future. Veterinary advice is to the effect that an animal may distribute the club-root organism in its excreta during the week following the consumption of club-root-infected material. Further, the club-root organism is known to survive in a soil

for several years without the presence of any suitable host. Consequently, one precaution that may be taken against the spread of club-root on a farm consists in selecting not less than three years ahead the areas to be used for crops subject to club-root, and then in not running on this area stock which have been feeding on club-root-infected crops until a week has elapsed. Further, club-root is readily spread on implements and on the hoofs of stock passing from club-root-infected land.

Special Needs of the Dairy Cow.

A point of great practical importance is the difference between the standard of winter feeding required by dairy cows and that required by other farm stock. It may be economically sound at times to allow sheep and store cattle to be on such short rations that they fall off in condition during winter. As a general rule, with very few exceptions, it is highly inadvisable to keep dairy cows on short rations during the winter. The dairy cow normally carries no surplus condition at the end of the milking-season. For her the period in which she is not producing milk could well be one of recuperation and of replenishing important bodily reserves. This can be achieved only if the cow is fed above the standard of mere maintenance instead of below it, as is the case of stock which fall off in condition. The sooner it is universally recognized that the modern dairy cow specifically calls for a higher standard of winter feeding than has been satisfactory with other farm animals the sooner will dairying be on a more profitable basis.

The Cereal Crops.

Seed-treatment for disease-control is a matter which should not be omitted in the spring sowing of cereals. It seems at times to be overlooked that smut is decidedly detrimental in an oat crop which is to be chaffed, and also that the Algerian oat is subject to smut, and that there is therefore just as much need to treat seed of Algerian as seed of the other oats. There is room for considerable expansion in the practice of suitably treating barley seed of all kinds. These and other matters of current interest in regard to cereal crops were dealt with in considerable detail in these notes in March and July, 1930, and March, 1931. Any one unable to refer to the information then published or desiring further information may obtain such information by applying to officers of the Fields Division.

Miscellaneous.

Whenever opportunity offers, the construction of any proposed ensilage pits or trenches should be proceeded with, in order that there may be ample time for the thorough settling-down of any earth disturbed in construction work before it is subjected to traffic or other pressure.

It may be proposed to save silage during the coming season and to utilize it during the customary dry summer period of grass shortage. Unless reserves of silage are already on hand it is inadvisable to depend for the coming summer upon silage which is still to be made. Such a proceeding is too much akin to counting one's chickens before they are hatched. It is far safer to look upon silage that it is intended to make during next summer as a reserve for the following summer, and in respect to the intervening period to follow past successful methods of making provision for supplementing the grass when it is in short supply.

If possible, grazing lucerne during winter and early spring should be avoided. This is specially true of young lucerne. Winter top-dressing of lucerne is almost always inadvisable, and this is particularly the case if grass invasion is taking place.

—R. P. Connell, Fields Division, Palmerston North.

THE ORCHARD.

Work for the Coming Month.

THE coming month should terminate pruning in the orchard, and early spring operations should be prepared for and undertaken. Late dormant sprays, manuring, and cultivation are operations which call for attention during August—it is not wise to leave these matters until September if maximum results are sought.

Delayed Dormant Sprays.

On pip-fruits at this season of the year, delayed dormant sprays should consist of bordeaux at a strength of 5–4–50, or lime-sulphur 1–10, the application to be made at "green-tip." It should be noted by fruitgrowers that delay in applying beyond this stage may, and often does, result in permanent russeting of the fruit, which may be attributed to other causes at a later period of the season. Rather than incur a risk in this direction growers are advised to apply bordeaux slightly earlier than green-tip, as illustrated in the Department of Agriculture's Bulletin No. 117. Bordeaux will retain its action under dry conditions for a long period, soluble copper being released after protracted periods when wet-weather conditions occur. Lime-sulphur 1–10 should be given preference to bordeaux in those districts in which powdery mildew is pronounced.

Stone-fruits: Peaches, plums, and nectarines must be given attention at bud-movement if efficient and adequate control of leaf-curl, brown-rot, and mock or bladder plum is sought for. Bordeaux 5–4–50, or lime-sulphur 1–15, may be regarded as efficient controls, with a preference in favour of bordeaux, and reverting to lime-sulphur 1–50 at the "early pink" stage.

Scions for Grafting.

The operation of reworking undesirable varieties will be undertaken during the month of September, necessitating the collection and conservation of one-year-old wood for this purpose during the latter end of August. Up to that time the scion wood is best left on the parent tree, so that the effect of a slight sap circulation may have commenced. To preserve the twigs in dormant and fully vitalized condition it is best to store the wood in damp washed sand in a cool place. By this method scions may be retained in good dormant condition sufficiently long to enable the operator to replace failures which may become apparent at a later date.

For detailed information on the subject of grafting fruit-trees readers may be referred to the Department's Bulletin No. 98.

Manuring.

On heavy land the main application of manure should take place during August; where light and porous soils exist a rather later period may be advisable. The method now finding favour with many commercial orchardists on clay lands is that of top-dressing during early August, prior to spring ploughing. At ploughing the fertilizer is turned under, thereby placing it in close proximity to the roots, where it becomes almost immediately available to the trees.

It should be remembered that the activity of the tree commences some time before it is apparent by the unfolding of the blossoms and leaves. The writer is convinced by experience that much can be done during this period of early spring towards further development of immature fruit-buds which would otherwise take another year to reach the blossoming stage. Where this result is desired only highly soluble manures should be applied.

Cultivation.

Ploughing should be undertaken when the ground is sufficiently dry to avoid puddling the heavier class of soils. An endeavour should be made to bring the ground into as friable a condition as possible, in order to stimulate bacterial action and to raise the temperature of the soil; also so that the disks may be brought into action as soon as possible to conserve the soil-moisture from the effects of dry spring winds.

—*M. Davey, Orchard Instructor, Mapua, Nelson.*

Citrus Culture.

The principal work in citrus orchards during the next few months will consist in harvesting the fruit as it becomes ready. In order to obtain the best results this should receive attention each month. Steady supplies of any kind of fruit should be an essential feature of all marketing operations.

Lemons should be cut from the trees as they reach the desired size, irrespective of whether they are green, silver, or yellow. The most profitable sizes are from 150 to about 200 per bushel case. Whether the fruit is to be handled by the Citrus Pool or packed by individual growers, the same methods should apply. The key-note of all marketing should be to present the product to the consumer in the best manner possible. This Dominion is seeking to grow sufficient lemons to supply all the requirements of the local market. The improvement made in the methods of handling has in a large measure overcome the prejudice that at one time existed against the local product. It therefore behoves every grower to see that he does nothing to cause a reaction. The locally produced lemons, if correctly grown and handled, compare very favourably with the imported fruit.

The Poorman orange is becoming popular as a substitute for the imported grape-fruit. One cannot therefore stress too strongly upon all growers to leave nothing undone that would bring into greater prominence and favour this fruit that is now being so successfully grown in Auckland Province. Remember the old saying, "Nothing succeeds like success."

The land is now fully saturated with water, and as we still have before us two months in which heavy rains may occur, citrus growers are urged to make adequate provision for the drainage of all surface water as it falls, otherwise the trees may become affected with collar-rot, or otherwise suffer in health.

—*L. Paynter, Orchard Instructor, Auckland.*

POULTRY-KEEPING.

Hatching Reminders.

If stocks of such breeds as Orpington, Wyandotte, Sussex, &c., are to be developed into profitable birds, hatching operations must not be delayed beyond August. This also applies to Minorcas, as birds of this breed usually take from four to six weeks longer before commencing their laying season than is generally the case with the popular White Leghorn.

Where winter eggs are the object aimed at, those who require only a small number of White Leghorn pullets for renewing stock will find, in most cases, that the best results will be obtained from chicks hatched towards the end of September. The great drawback to having the pullets hatched out too early is that they usually go into a moult with the

old fowls, just at a time when maximum prices are ruling for eggs. While August for the heavy breeds and September for White Leghorns are the most suitable months, it should be remembered that it is always better to have the chicks brought out a month too early than a month too late. Birds hatched in November and December are always undesirable.

While the date of hatching determines to a large extent the quality of the chickens produced, there are other factors that must be considered if the birds are to develop well and be really profitable. The first essential is to see that the parent birds are maintained in a healthy and thriving condition, and are fed and managed in such a way that the eggs produced will contain the desired strength of germ, so that when the chickens are hatched they will be constitutionally strong from the outset and easy to rear.

It is necessary that the male birds should be maintained in good condition, otherwise weak germs and a high percentage of infertile eggs are sure to be produced. Male birds should be frequently handled, and if their weight is less than normal they should be replaced, or else be given a good meal by themselves at midday. Special care should be exercised in selecting eggs for hatching purposes. A mistake often made in this connection, particularly by the ordinary farmer, is to gather eggs for hatching indiscriminately from a large flock of hens. To build up or maintain a heavy-laying strain it is imperative to have a breeding-pen, so that only eggs from those birds possessing undoubted laying qualities and constitutional vigour are used for reproductive purposes.

Artificial Incubation.

Hatching chickens by means of incubators is an important work in connection with the poultry plant, but as there are no two incubators on the market which require exactly similar treatment it is impossible to lay down any general instructions applicable to all machines. The best advice to novices is that they should try no experiments, but should follow closely the instructions sent out by the maker regarding the working of the particular incubator which it is proposed to use. It is true that to experiment is one of the best means of gaining knowledge, but where the success or failure of a plant depends upon the result it is obviously one of the things the novice should avoid.

It is only safe to depart from the maker's instructions when the operator has had considerable experience in incubation work, or when he is following the advice of a man of experience. Indeed, where possible, it is a wise course for the beginner to consult a man of experience and to witness a practical demonstration of the working of the machine. Such a demonstration will give the novice more confidence in the work, while it may save much subsequent loss and disappointment. The novice would also be well advised to select an incubator from among those makes that have proved their value to our successful poultrymen, rather than be led into buying a cheap inferior article on a trade advertisement only. Correspondents, when asking for information regarding the troubles they encounter in the work, should always give the name of the particular machine they are using.

Brooder Management.

Success in raising chickens where artificial means are employed depends largely on the observance of the many small details connected with this important work. A comfortable degree of warmth under the hoover is the first essential, and then care must be taken to see that plenty of fresh air is available to the chicks at all times. The person who is successful in rearing brooder chicks leaves nothing to chance. In the first place he sees that his breeding-stock are in the best possible condition for the production of vigorous progeny. When the chicks are hatched out he keeps

a close watch on them, and on the first sign of anything wrong he looks for the cause and removes it. He also takes climatic conditions into account, and sees that the correct degree of heat is maintained both by day and night under the hoover, as well as an ample supply of fresh air. This means long hours of work and giving the young birds almost constant attention.

With regard to success or otherwise in artificially rearing chicks too many poultry-keepers fail to follow the set of practical instructions provided by the mother hen and her brood. They attach chief importance to the food supplied. Good food is certainly an essential, but it is only one important link in the chain of management, as the best food ration ever planned will fail to produce the desired results if the management is not correct in all other respects. For example, it is common to see chickens with the mother hen doing remarkably well on a class of food that would, on its appearance alone, be condemned for brooder chickens. The obvious lesson is that warmth at a uniform temperature is more essential than the providing of any special ration for the young birds. Herein is seen the prevailing weakness of artificial rearing. The chickens seldom enjoy that absolutely uniform degree of warmth and fresh air which they receive when being reared in the natural way. The hen studies weather conditions, and so must the poultry-keeper if he is to rear his chickens successfully.

Unless a uniform degree of warmth is maintained the chickens will become chilled, and as a result they will resort to huddling, each one trying to secure an inside position, which is naturally the warmest. Thus in the huddling effort, combined with the constant pressure on their undeveloped legs, these soon spread, and as a result an affected bird will present a wabbling walk in its endeavour to move about. Many cures have been recommended for this trouble, such as the use of tonics, &c., but the best of these will prove of little value unless preventive measures are adopted, the chief among which is providing the degree of warmth instinctively demanded by the chickens, care being also taken to see that plenty of bedding material is provided.

Poultry-keepers, especially those who use the canopy type of brooder for rearing chickens, would be well advised to use the anti-sweating device described by Mr. A. H. Kitto in an illustrated article on "Green-leg of Chicks" in the *Journal* for January last. This consists of a wooden frame, with wire netting stretched across it covered with sacking.

For young chickens to do their best it is essential that they have plenty of exercise. In this connection some people make the mistake of placing the food in troughs at all times, thus giving the chicks no special inducement to scratch for their food as nature intended. For the first few days it is well to feed the chicks on shallow trays or something similar, but after this a good portion should be fed in a manner that will induce them to scratch and keep busy. With this end in view the brooder runs should be covered to a depth of about 2 in. with straw chaff, in which the broken grains, seeds, &c., are scattered. It is natural for healthy chickens to scratch and keep busy, and if not given the opportunity to do so trouble may sooner or later be expected from toe-and-vent picking, and other bad habits, to say nothing of the fact that they will cease to thrive.

Oaten chaff should never be used for scratching material, especially when the chicks are young, as they are apt to eat the oats, with the result that the husks become a hard mass in the gizzard and the bird soon dies of starvation. Chickens often die from eating the joint of the grain stalk in the chaff and other fibrous material. If a supply of fine sharp gravel grit is always available to the chicks right from the start, it will go a long way towards preventing trouble in this respect. In addition to gravel grit, finely broken sea-shell should be in reach of chickens of all ages, as a means of providing lime for bodily requirements.

Another important point in the management of brooder chicks is to keep the different ages as distinct as possible, so that the treatment may harmonize with the stage of development of the birds. The best results will never be secured unless the chickens of different ages are penned separately and the treatment of each pen is in uniformity with the special demands of the particular occupants.

—F. C. Brown, Chief Poultry Instructor, Wellington.

THE APIARY.

Preparations for the New Season.

DURING the dormant season all spare time should be spent in making preparations for next season's work. All defective supers, roofs, and bottom-boards should be overhauled and, where necessary, given a good coat of paint. This work, if delayed, is apt to interfere with the main work in the apiary when the bees are calling for special attention, and it should not be postponed.

If it is desired to increase the apiary, hive and frame making should be pushed on, and ample provision made for increase before the actual time arrives for putting preconceived plans into operation. Where the beekeeper does not make his own hives he should now order sufficient stocks to see him through the season. In the majority of cases it does not pay to make one's own appliances. Hive-manufacturing in the Dominion has been brought to a high standard, and unless the apiarist has ample capital to purchase machinery to turn out good hives he will find the home-made article too costly in the long-run.

Whether the beekeeper is working on a small or a large scale he should aim at uniformity, and in building up an apiary decide at the beginning on the style of hive and frame he is going to use, and continue on those lines. Non-fitting supers and frames mean extra labour, and lead to endless trouble. In the past, manufacturers have been greatly to blame for continually altering the type of hive placed on the market, and consequently beekeepers have found great difficulty in keeping appliances uniform. As yet no regular type of hive has been adopted for the Dominion, but the dovetailed hive now so popular among beekeepers is easily the best offered by the suppliers. The sizes in use are mostly ten- and twelve-frame, and experience of his district will enable the beekeeper to decide as to the best one to adopt.

To meet those cases where cost is a consideration a durable frame hive can be made out of a petrol case, which will comply with the provisions of the Apiaries Act. Petrol-cases are obtainable for a few pence each, and can be readily converted by any one handy with tools. A kerosene case may also be used, but it will be found necessary to reinforce it, so that the petrol case is the handier. Particulars of a cheap home-made hive are given in Bulletin No. 128, "Beekeeping."

Overhauling the Hives.

As advised last month, all supers should be removed and the bees confined to the brood-chamber. This will keep the bees snug and promote brood-rearing, and at the same time facilitate the work of giving the hives their first spring overhaul. During the course of the winter there is usually an accumulation of pollen, dead bees, &c., on the bottom-boards, and consequently the latter require cleansing. All operations at this period should be carried out quickly as a safeguard against robbing. To cleanse the bottom-board bring into use a spare board; set the hive temporarily

on the spare board while scraping and cleansing the permanent one; then replace the hive on its permanent stand. See that the hives have a slight cant towards the entrance; this will prevent moisture settling on the bottom-board, which is apt to cause the death of a considerable number of bees, besides making the hive damp and unwholesome.

Early Spring Examination of Colonies.

During August, whenever the temperature will allow, the colonies may be given their first examination. It is highly important that this work should not be postponed until brood-rearing has started in earnest, more especially in cases where ample stores were not left to carry the bees over the early stages of this important function. Delay in making an examination may lead to spring losses, and nothing is more annoying than to find colonies dead through neglect to provide sufficient stores. Usually a colony's requirements are attended to in the late autumn, when the apiarist endeavours to gauge the amount of food requisite to carry the bees through the winter and spring periods. It may happen, however, that mild weather will be experienced, when the drain on the stores to feed the young bees, if not supplemented, may reduce a colony to starvation. Nothing should be left to chance during the critical months of spring, and no effort spared to see that each individual colony has sufficient food to meet current demands. Colonies which contain 15 lb. to 20 lb. of honey may be left until a later examination. If the hives contain less they should be watched closely and preparation made for feeding. See Bulletin No. 128, page 77, regarding the spring feeding of bees.

Queen-right Colonies.

Next to the item of stores the most important factor in a colony's condition is its queen. Advantage should be taken of the first examination to see that the queen is all right. If a colony is in normal condition as regards strength and stores there should be fair-sized patches of brood in the centre frames, but this is not sufficient to determine that the colony is queen-right. The cells adjacent to the brood should be quickly examined for eggs, which are the only indication that the queen is present. If neither brood nor eggs are found, then shelve the question of the colony being queenless till about ten days later. At each examination make a note of each hive and its condition for future reference.

—E. A. Earp, Senior Apiary Instructor, Wellington.

HORTICULTURE.

Making a Hotbed.

In Northern Europe, where the winters are cold, the population dense, and the consequent demand for early produce is very considerable, heated beds are used extensively. One of the latest methods of heating beds of this kind is to lay electric cables in sand or ash, which is then covered with soil in which the crop is grown, in frames with sash-lights. The total running-cost, with current at 0·72d. per unit, has been worked out at 7·5s. per square metre, as compared with 7·8s. per square metre for hotbeds made of manure (1 metre = 39·37 in.). In most cases there is the extra cost of a transformer to reduce the current to the requirements of a 40 volt system.

Under the milder conditions of climate which we enjoy, and in the absence of the numerous large cities which create so large a demand, hotbeds for horticultural purposes are not needed on a large scale. Still, for raising young plants of such half-hardy crops as tomatoes, cucumbers,

melons, egg-plants, peppers, &c., a hotbed is required, and if one is specializing on the production of such crops it may be of considerable area. The seed-boxes do not take up much room, but after pricking-out the young plants one is often hard put to it to find hotbed accommodation. Where the crop is to be grown in unheated glasshouses, or outside, a properly constructed hotbed of stable manure is sufficiently warm to meet most requirements under our conditions.

Owing to improper construction the heat generated by the action of fermentation is often irregular, low, or lost altogether. This can be avoided by taking a little more time and care in construction. Manure that is partially or completely decayed has passed through the stages of fermentation, and the material is breaking down; it is useless for the purpose of a hotbed, as it is an unsuitable medium for the bacteria which bring about the phenomenon which we know as fermentation. For this purpose the stable manure must be fresh. Where it is scarce, leaves or other unfermented vegetation may be added or even substituted, although not with as good results.

The bacteria of fermentation are everywhere present in the surface soil and on all crops. They may be cultivated and their action stimulated by stacking the moist material for the hotbed compactly in a sheltered place. In four or five days under these favourable conditions a high temperature is reached, and the material should then be turned, shaken out, and restacked compactly, meanwhile watering any portions that are dry. On the occasion of this first turning one usually finds the ferment is active in some portions of the mass but not in others, and by mixing and moistening the dry material the conditions are made more uniform. After a similar interval the turning and watering should be performed for a second time. A few days later, when the whole mass is in an active state of fermentation, it is ready for building the hotbed.

The position for this should naturally be dry, warm, and sheltered. Shake the material out, spread it evenly, tread it firmly, and build up a neat stack big enough for the frame to rest on it securely. In a few days a steady heat will have generated, and the bed should be watered and the sashes placed in position. The hotbed is now ready for use. The successive turning and moistening is necessary to set up fermentation through every part, as it is only then that the full benefit is obtained both in the amount of heat and the period for which it lasts.

The height of the bed will depend on the heat required. In warm localities a foot or two of the material packed in the bottom of a pit or frame will supply sufficient heat, about the end of August, for raising half-hardy annuals for planting out two months or so later. The warm, moist atmosphere created in the frame is very suitable for encouraging plant-growth. To seedlings water should be applied sparingly at this season, and then it should be tepid. When the seed germinates it must have light and air as well as moisture and heat. Results depend very much on how these are given, and they should always have careful consideration in this respect while the crop is growing.

At this stage "damping-off" fungi present in the soil will attack young seedlings under certain conditions. These are chiefly moisture, warmth, and closeness. The least neglect or lack of skill is therefore likely to cause serious loss. To avoid this loss, and trouble with weeds, the soil for seed-boxes is sometimes sterilized with steam. Or the fungus mycelium and spores may be destroyed by a chemical fungicide; a 2-per-cent. solution of formalin is often used, or a 1-per-cent. solution of acetic acid, which has given good results in tobacco-seed beds, may be tried. Such treatment is best done three weeks or so before the seeds are sown. Although damping-off losses are eliminated in this way, it is still important to give the crop the best attention and so obtain strong sturdy fruitful plants.

Preparation of the Land before Sowing or Planting.

The final preparation of the land for the hardy early and main crops now being planted should receive close attention. It was probably cleared three months ago, a good dressing of farmyard manure turned in, or a green crop turned under, and the surface left rough. Cultivation should now be given to destroy weeds and fine the surface, ready for sowing or planting. Repeat this two or three times at intervals, taking quick advantage of suitable weather as it occurs. Just before the last treatment make a dressing of soot, wood-ashes, and chemical manures, as is desirable, and work the material in. At the next really dry spell drill the seed, making careful adjustment so as to sow thinly and avoid the necessity of thinning the seedlings. This occasional opportunity of a few weeks' fallow in the spring should be used to best advantage; it affords an excellent opportunity for cleaning the ground easily and effectively, as hoeing weeds after the seed is once sown is a slow and hazardous undertaking if they are at all numerous.

As regards manures at this stage, a fair dressing of superphosphate and a smaller dressing of sulphate of potash is generally good, deferring the application of nitrogenous chemical manures until the plants are well established. Soot is an excellent nitrogenous manure if it is stored for some time to allow injurious sulphur compounds to oxidize. It also contains carbon that is beneficial, and has some insecticidal properties that are useful. It should be stored in a dry place, as also should wood-ashes, which are rich in available potash.

Vegetable Crops.

The arrangement of these crops requires careful consideration to make the best of a suitable rotation. It is a common sight to see land cropped repeatedly with one kind of produce until it fails. A change is then made to another kind and a bountiful crop obtained. Such changes should be made more frequently. The land would then be comparatively free from injurious organisms and in better heart in every way. There is a suitable rotation for every class of soil and locality, and too much consideration cannot be given to it for commercial production. This applies especially to annual crops and such as occupy the land for short periods.

In addition to the crops mentioned last month, which may still be planted, sow parsnips, early peas, shorthorn carrots, white turnips, globe beet, and parsley.

Where birds and vermin are troublesome, the seeds may be shaken up in a canister with a little powdered red lead; and in the case of larger seeds, such as peas, they may be sprinkled with kerosene first and afterwards dried before sowing.

Tuberous artichokes make a useful dish during the winter months. If a good strain is planted now a generous crop is assured with very little attention.

Early potatoes may also be planted. The crop is in good demand and may be grown now with comparatively little risk of disease in the warmer localities. The chief difficulty is getting seed true to name and free from disease, especially those mysterious troubles known as virus diseases. The careful grower will probably have built up sound stock by careful selection, or he may obtain seed grown under the supervision of the Department of Agriculture and certified in regard to the respects above mentioned.

The light lands of this country are very suitable for asparagus culture, especially those that are moist but well drained. The land should be rich as well as light, and care should be taken to assure this point before planting, as asparagus is a long-lived crop and only superficial applications of fertilizer can be made afterwards. The crop is quite hardy—in fact, it

is considered to do best where it has a definite period of rest during the winter. Good, large, selected one-year-old plants are suitable for planting out. These may be obtained by sowing the seed now, and so securing a long season of growth. Good plants should then be available for planting out at this period next year. Sow the seeds thinly, so that plants will be spaced 3 in. or 4 in. apart, and cover with about 2 in. of soil. A space of 1 ft. to 2 ft. should be left between the rows, as is most convenient for working. A good area should be sown to enable a selection to be made of the bigger plants only for setting out as a permanent crop. Established crops should be given a dressing of nitrate of soda so soon as growth commences.

Rhubarb also may be grown from seed, but usually it is best propagated by the division of selected roots. By this means an even high standard of produce is obtained. As with most perennial herbaceous plants, production falls and the plants deteriorate after they have been growing for three or four years in one place. It is time then to lift the roots, cut them up, and replant. For this purpose the land should receive special preparation; it should be trenched or double-ploughed and given a heavy dressing of farmyard manure. Before planting a good dressing of bonedust should be turned in and an ounce or two of superphosphate per square yard should be applied. The plants should then be set out 2 ft. to 3 ft. apart and covered with two or three inches of soil. Established crops should now be given a dressing of superphosphate.

Tomatoes under Glass.

If the soil in the unheated glasshouse is well cultivated, fertilized, and sufficiently moist it will be ready for setting out the plants during this month. The plants should be prepared for this by carefully hardening them off sufficiently for their new environment. They are very sensitive, and injury commonly done to them at this stage by insufficiently recognizing the fact is very considerable, and frequently is the cause of serious loss to the grower. If great care is taken at this critical period to avoid chilling the plants they will continue growing without a check, which will result in bigger and better crops with early maturity.

In heated houses, where the plants will be setting their fruit, careful attention must be given to ventilation. It is not sufficient to maintain merely the requisite temperature, but the humidity also must be kept down if the blossom is to set freely and the plants be maintained in robust vigour. This is best done by giving sufficient ventilation on every suitable occasion to release the humid atmosphere which is bound to accumulate occasionally.

Small-fruits.

Strawberries and other small-fruits should be given a dressing of such fertilizers as may be required, and shallow cultivations in bright weather when the land is dry to destroy weeds. Bordeaux spraying at intervals of two or three weeks will be necessary in most cases to control fungus disease, especially the troublesome leaf-spots of different kinds which are very commonly found in these crops.

The Homestead Garden.

Where new lawns are to be sown during the springtime the work is best done during the month of August in most districts. The surface should at least be smooth; in most cases it will need to be carefully graded, for the appearance of a lawn depends very much on doing this well. The level and fall of the surface of the land must be carefully adjusted to suit the position if the lawn is to be quite successful. This demands a great deal

of consideration and labour, but once it is accomplished the result is permanent, and the lawn will always be a dominant feature in the garden.

Another important fact at the present time is that end of the "planting season"—the time for planting trees and shrubs—is reached with the end of August. It may be continued for a while in districts with a good rainfall, but generally it can only be prolonged at some risk of incurring losses. To avoid this, planting should be completed as soon as possible when the land is sufficiently dry.

In the warmer districts roses should now be pruned. This consists chiefly in thinning out the growth and cutting back what is allowed to remain, so as to admit light and air, also to encourage vigorous growth. As the plants flower on the new wood, this is necessary if good blooms are to be obtained. Cutting back may be carried to excess, but more commonly one finds the plants crowded with weak wood and flowers that are consequently not so attractive as they might be. With experience, the art of developing an even well-balanced tree is acquired.

In the herb garden the following hardy annuals may be sown in August: Chervil, coriander, dill, parsley, purslane, summer savoy, and angelica. The last-named requires rather a moist situation. Caraway, a hardy biennial producing the well-known aromatic seeds, may also be sown.

—W. C. Hyde, Horticulturist, Wellington.

AN AMERICAN INVESTIGATION ON ST. JOHN'S WORT.

St. John's Wort on Range Lands of California. A. W. Sampson and K. W. Parker, Bull. No. 503, December, 1930. University of California, Berkley, California.

St. John's Wort (*Hypericum perforatum*), a weed tending to become a pest in certain New Zealand pastures, is stated by Sampson and Parker to be "probably the cause of the heaviest of financial losses found on pasture and range lands of California." They give an account of its botanical characters, present distribution, and the methods of control being attempted. Feeding experiments showed that both sheep and cattle are affected. Though the actual death-rate is small, the writers consider that there is a serious loss in condition, especially in sheep. The symptoms are given as "high temperature, rapid pulse and respiration, tendency to diarrhœa, mild dermatitis, and in some cases salivation." No insect attack of any consequence has been reported in the United States, but the introduction of "natural enemies" from Europe is recommended, provided the proper safeguards are undertaken. A study was made of various mechanical methods of control—digging, cutting, covering, flooding, burning. Burning was found to increase the weed and favour germination of seed, while the other methods were either ineffective or too costly to be used on a large scale. Overgrazing was found to be a mistake, but grazing with goats, which relish the foliage and young stems, and suffer only very mild poisoning, is considered worthy of further trial. Spraying with sodium chlorate was tried at various seasons of the year. Highly favourable results were obtained from autumn and early spring applications with a concentration of 15 per cent. Spraying at the blossoming stage was not effective. A second spraying about three weeks after the first is recommended to kill plants that escaped.

—H. H. Allan, Systematic Botanist, Plant Research Station.

CERTIFICATION OF SEED POTATOES.

CROPS PASSED TUBER INSPECTION TO 30TH JUNE, 1931.

FOLLOWING is a list of growers whose crops have been subjected to and have passed the tuber inspection in connection with the system of Government certification of seed potatoes conducted by the Department of Agriculture. The list comprises those crops passed up to 30th June; further lists will be published later.

In the June *Journal* was published a list of growers who had received provisional certificates. The acreage, cropping-power, and percentage of foreign varieties present were given in that list, to which intending purchasers should refer.

Aucklander Short-top (N.Z. Sutton's Supreme).

W. Oakley, R.M.D., Halkett.
H. A. Hancock, Awahuri.
R. S. Roper, R.M.D., Halkett.
J. Petrie, jun. (Line D), Swannanoa.
A. J. Rich, R.M.D., Kaiapoi.
R. Barnett (Line A), Dunsandel.
J. Petrie, jun. (Line A), Swannanoa.
W. E. Martin (Line A), R.M.D., Kaiapoi.
J. Warren (Line B), 149 Russley Road, Fendalton.
M. Breen, Levels.
A. F. Brown (Line B), Woolridge Road, Harewood.
Gardiner Bros., Upper Waitohi, via Temuka.
J. W. Ferguson, Upper Winchmore, Methven.

Aucklander Tall-top (N.Z. Sutton's Supreme).

J. Warren, 149 Russley Road, Fendalton.
H. S. Moore, Box 4, Kaiapoi.
Hampton Bros., Pareora, via Timaru.

Dakota.

G. Gudex, Levels.
H. Smythe, care of G. G. Wanson, Darfield.

Bresee's Prolific.

D. Marshall, R.M.D., Killinchy.

King Edward.

Gore Experimental Area, Gore.
J. L. Caulfield, Glencoe R.M.D., Invercargill.
L. A. King, Glencoe R.M.D., Invercargill.

Epicure.

G. McLachlan, R.M.D., Southbridge.
D. Marshall, R.M.D., Killinchy.

Majestic.

R. Borthwick, Darfield.

Early Regent.

J. Curragh, Templeton.

Early Rose.

R. G. Robinson, 12 North Road, Papanui, Christchurch.

Robin Adair.

D. Marshall, R.M.D., Killinchy.

Correction.—In the list of provisional certificates published in the June *Journal* the entry, under the variety Early Rose, of "A. F. Brown, Woolridge Road, Harewood," should read "R. G. Robinson, 12 North Road, Papanui, Christchurch."

—*Fields Division.*

Noxious Weeds Order.—The Waitaki County Council has declared African boxthorn (*Lycium horridum*) to be a noxious weed within the County of Waitaki.

Varying Weight of Apples.—Mr. G. Stratford, Orchard Instructor, Motueka, reports as follows: "During the past fruit-export season it was noticed that some cases of apples were much heavier than others of the same variety, size, &c., depending upon the district in which the fruit was grown. In consequence, two packed cases of apples similar in every respect—cases, variety, number of apples in case, pack, bulge, &c.—were weighed, with the following result: Fruit grown at Mariri (Moutere Hills), 109 lb.; fruit grown at Riwaka (good flats), 99 lb.—a difference of 10 lb. in favour of fruit grown on the hill country."

WEATHER RECORDS: JUNE, 1931.

Dominion Meteorological Office.

General Notes.

June saw the cold conditions which have now persisted almost continuously for two years again strongly developed. Several very widespread snowfalls occurred and severe frosts were recorded, especially in the second half. Except in Wellington Province, the rainfall was generally considerably below normal. Parts of South Canterbury and Otago, particularly, are feeling the long shortage of precipitation. The low temperatures of the latter end of the month effectively checked the growth of vegetation. Supplementary feeding of stock is being resorted to in many districts, but the animals are reported to appear generally to be in good condition.

Rainfall.—Owing chiefly to heavy falls between the 12th and 14th, Wellington Province generally experienced an excess of rainfall. More than the average was experienced also at scattered places elsewhere in both North and South Islands. Low rainfalls, however, were the rule, and at many places heavy deficits were recorded.

Temperature.—Temperatures averaged over two degrees F. below normal for the Dominion, the month being particularly cold in Canterbury and Otago. There were numbers of severe frosts, especially at the end of the month. On the 6th the lowest grass minimum temperature hitherto recorded at Rotorua (15° F.) was reported, while on the 30th 9° F. was recorded at Gore and 7° F. at Fairlie. There were four periods of widespread snowfall—2nd–5th, 14th–16th, 22nd–24th, and 28th–29th.

Sunshine.—The amount of bright sunshine recorded was, for the Dominion as a whole, approximately the average for June.

Winds.—As would be expected from the remarks regarding temperatures, southerly winds were more frequent than usual. Southerly gales were severe in some part or other of the country on 4th–5th, 16th–17th, 23rd, and 26th. That of the 26th was very heavy between Cook Strait and Banks Peninsula. That of the 23rd was felt most severely in Canterbury and Otago, where considerable damage of a minor nature was done.

Storm Systems.—On the 4th a vigorous depression of the westerly type passed south of New Zealand. Southerly gales blew in its rear, and snow fell on the high levels. Hail showers, also, were experienced in the South.

After a spell of fine weather associated with an anticyclone which passed on the 8th, an irregular series of depressions crossed the Dominion between the 10th and the 14th. There was much heavy rain in western districts and in Wellington Province, where considerable flooding occurred.

A deep cyclone, the centre of which crossed the northern extremity of the North Island during the 16th and 17th, brought heavy rain to North Auckland and the eastern districts of the North Island. Southerly gales blew after the centre had passed.

On the 23rd a cyclone centre developed to the eastward of Canterbury in a complicated depression which had been moving eastward during the preceding three days. This storm was responsible for a severe snowfall on all the high levels and also on some of the plain country of the South Island. Numerous hail-storms also were reported. The southerly gale of the 23rd has already been mentioned.

The last storm of the month reached New Zealand on the 26th, barometers falling to below 29 in. in the far South. Heavy southerly gales occurred on the 26th, and gradually blew themselves out during the following three days. Heavy rains fell in Wellington Province and parts of the South Island. Snow was exceptionally widespread on the 28th and 29th. Thunderstorms were experienced in the central western areas of the Dominion. These were particularly severe in the neighbourhood of Wanganui, where some damage was done by lightning discharges.

RAINFALL FOR JUNE, 1931, AT REPRESENTATIVE STATIONS.

No.	Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average June Rainfall.
	North Island.	Inches.		Inches.	Inches.
1	Kaitaia	6·24	19	1·13	6·71
2	Russell	3·06	12	1·70	6·64
3	Whangarei	5·04	22	1·57	6·62
4	Auckland	5·10	21	1·20	4·96
5	Hamilton	4·86	18	1·00	5·12
6	Rotorua	3·32	14	0·79	5·29
7	Kawhia	4·13	18	0·61	5·71
8	New Plymouth	5·29	16	1·07	6·18
9	Riversdale, Inglewood ..	8·75	18	1·61	10·22
10	Whangamomona	8·46	13	1·84	7·99
11	Eltham	5·21	18	0·75	5·84
12	Tairua	7·12	14	2·52	7·13
13	Tauranga	4·36	16	1·68	5·37
14	Maraehako Station, Opotiki	3·95	17	1·32	5·87
15	Gisborne	3·99	15	1·85	5·04
16	Taupo	3·66	14	0·69	4·61
17	Napier	3·13	17	0·55	3·55
18	Hastings	2·91	17	0·73	3·37
19	Taihape	4·77	20	0·83	3·23
20	Masterton	4·31	18	0·87	3·72
21	Patea	4·78	17	1·05	4·21
22	Wanganui	4·23	13	1·10	3·32
23	Foxton	4·87	14	1·30	3·26
24	Wellington	5·71	17	1·24	4·19
	South Island.				
25	Westport	9·12	13	2·20	8·85
26	Greymouth	7·52	11	2·10	8·74
27	Hokitika	7·12	12	2·14	9·43
28	Ross	8·24	9	2·13	8·89
29	Arthur's Pass	20·29	8	7·32	10·28
30	Okuru	6·53	8	1·78	11·04
31	Collingwood	8·45	12	1·39	10·39
32	Nelson	2·75	11	1·27	3·62
33	Spring Creek	2·20	10	0·50	3·14
34	Tophouse	5·71	11	1·08	5·00
35	Hanmer Springs	2·77	13	0·76	3·21
36	Highfield, Waiau	2·46	8	0·76	2·53
37	Gore Bay	2·05	10	0·92	2·93
38	Christchurch	3·56	13	1·98	2·69
39	Timaru	0·46	8	0·20	1·83
40	Lambrook Station, Fairlie ..	1·03	6	0·38	1·96
41	Benmore Station, Clearburn	1·67	12	0·43	1·89
42	Oamaru	1·53	10	0·61	2·05
43	Queenstown	2·64	12	0·75	2·34
44	Clyde	0·91	8	0·27	0·94
45	Dunedin	1·69	14	0·43	3·17
46	Wendon	2·75	11	0·73	2·51
47	Gore	..	..	..	2·83
48	Invercargill	4·20	20	0·95	3·58
49	Puysegur Point	4·71	21	0·47	6·52
50	Half-moon Bay	4·08	17	1·07	4·64

—Edward Kidson, Director of Meteorological Services, Wellington, 6/6/31.

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

BONES FOR ORCHARD.

"BONES," Cromwell :—

I am able to procure a large quantity of bones from a slaughteryard. I have been advised that by ploughing deep and burying these between the trees it would be beneficial to the apples, apricots, and peaches in the orchard. Would you please tell me if this is correct? If not, what is the best way to use the bones for manure for the orchard?

The Horticulture Division :—

Charred or crushed bone—*i.e.*, bonedust—is a popular fertilizer, but ploughing in a quantity of bones from a slaughteryard, as suggested, would be of very doubtful benefit to orchard fruit-trees, as bones take so long to decay and it would be a considerable time before their fertilizing properties became available to the trees. You may, however, be interested in the following directions for dealing with bones which appeared some time ago in the *Queensland Agricultural Journal*: "Pack the bones layer by layer with fresh wood-ashes in a barrel or bin, and keep the mixture moistened for some months, when they will be reduced to a powder. Or make a caustic liquor of five parts by weight of caustic soda or seven parts of caustic potash dissolved in fifteen parts by weight of water to fifteen of bones. In this they will disintegrate in a week. Another method of softening bones and making them friable is by mixing them in heaps with quicklime and loam. A layer of loam 4 in. deep is first spread, and on this is placed a layer of bones 6 in. deep, and above this a layer of quicklime 3 in. deep. Repeat the process till the heap is of convenient height, when it should be covered all over with a thick layer of earth. Holes are then bored in the heap from the top and water poured down to slake the lime. In two or three months the whole heap is friable and may be mixed and spread as a manure on the land."

STORING OF MANGELS.

R. G. V., Waverley :—

Could you let me know which is the best way to store mangels. Last year I put them under pine-trees spread out on hay, but it did not seem a success. They were pulled early in July, but in late September were still hard and a lot had rerooted. In stacking, should the tops be screwed off?

The Fields Division :—

When dealing with the crop pull the mangels and cut off the tops, being careful when doing so to leave as much neck as possible. If the top is severed too closely to the crown the mangel will bleed, thus causing loss of nutrients and probable decay. A dry situation should be selected for the storage site, and pitting should be done in the driest weather possible at the season. If the roots are pitted when wet or frosted undue heat is generated, and rot immediately develops. The clamp or pit should be long and narrow; 6 ft. in width at the base is sufficient. Covering is not requisite excepting in districts where frosts are severe. A light covering of straw is all that is necessary.

TOMATO GLASSHOUSE INFESTED WITH EEL-WORM.

"SUBSCRIBER," Heathcote Valley :—

As my tomato glasshouse is infested with eel-worm, I would like some advice about it. It is intended to renew the earth to a depth of about 6 in. Would other treatment be necessary?

The Horticulture Division :—

Your proposed treatment of the tomato glasshouse infested with eel-worm would be satisfactory. The soil should be removed for about 8 in. in rather wide trenches, and the subsoil dressed with a good fumigant before bringing in the new soil.

INVENTIONS OF AGRICULTURAL INTEREST.

APPLICATIONS for patents, published with abridged specifications in the *New Zealand Patent Office Journal* from 21st May to 2nd July, 1931, include the following of agricultural interest :—

Nos. 64792 and 66391. Seed-box attachment to plough; W. H. Barber, Ongarue. No. 65556 : Plough-lifting device ; J. Middlemiss, Woodlands. No. 65014 : Preparing fresh fruit for market ; Brogdex Co., Los Angeles, U.S.A. No. 65186 : Hay-grab ; H. D. Sorensen, Te Aroha. No. 65282 : Teat-cup : A. J. Harrison and C. E. Johnson, Whiteman's Valley, Upper Hutt. No. 66716 : Hay-sweep ; D. McL. Wallace, Ltd., Te Aroha. No. 66804 : Cow-bail ; J. Davies, Eastwood, N.S.W. No. 64833 : Wire-strainer ; P. Fischbach, Gisborne. No. 66608 : Wire-strainer ; A. E. Scott and J. Littlejohn, Auckland. No. 67024 : Seed-sowing implement ; T. McCall, Glasgow, Scotland. No. 64826 : Seed-disinfectant composition : Imperial Chemical Industries, Ltd., London, England. No. 64983 : Castrating-appliance ; L. Daroux, Manakau. No. 65915 : Wool-bale fastener ; R. W. Monten, St. Kilda, Vic. No. 66483 : Ploughshare ; Reid and Gray, Ltd., Dunedin.

Copies of full specifications and drawings in respect of any of the above may be obtained from the Commissioner of Patents, Wellington, price 1s. prepaid.

NUMBER OF PERSONS ENGAGED IN FARM-WORK.

THE number of persons engaged in farm-work on holdings in 1929–30 was returned as 138,121, as against 138,609 in 1928–29. Particulars for the two years are as follows :—

	1928–29.		1929–30.	
	Males.	Females.	Males.	Females.
Occupiers and members of occupiers' families	80,172	22,964	87,894	17,316
Other persons	32,713	2,760	31,427	1,484
Totals	112,885	25,724	119,321	18,800

When using these figures it should be borne in mind that they include working proprietors or managers and such members of their families as are engaged during the major part of their time on the work of the farm. No attempt has been made to include the great number of temporary workers who are employed on farms during harvest, the aim being rather to account for those who obtain their living by regular, consistent following of rural pursuits, whether as employer or as employee.

—*Census and Statistics Office.*

Correction.—In the second paragraph under the table of Dairy Factories on page 455 of last month's *Journal* the words " In the 1929–30 period " should read " In the 1930–31 period."

VARIETIES OF APPLES AND PEARS PASSED FOR EXPORT, SEASON 1931.

THE following particulars of the varieties of apples and pears exported from New Zealand in the past season have been compiled by the Horticulture Division from export certificates. The figures for apples represent bushel cases, and those for pears bushel cases or crates containing about 40 lb. of fruit.

Apples.

Sturmer Pippin, 373,444; Delicious, 287,413; Jonathan, 240,615; Cox's Orange Pippin, 74,354; Dunn's Favourite, 73,202; Dougherty, 63,957; Statesman, 38,981; Ballarat, 23,826; Cleopatra, 14,262; Rome Beauty, 12,162; London Pippin, 11,829; Worcester Pearmain, 9,780; Lord Wolseley, 7,652; Rokewood, 7,385; Tasma, 6,330; Granny Smith, 6,176; Stayman's Winesap, 4,674; Newtown Pippin, 3,964; Adams Pearmain, 3,264; Premier, 3,259; Scarlet Nonpareil, 3,248; Pioneer, 3,093; Spitzenberg, 2,018; Alfriston, 1,544; Yates, 1,449; Brighton, 1,146; Stark, 1,091; Washington, 1,022; Shorland Queen, 901; McLiver's Winesap, 833; McIntosh Red, 824; King David, 778; Salome, 693; McMahon's White, 642; Parlin's Beauty, 613; Brownlee's Russet, 601; Stone Pippin, 576; Ribston Pippin, 553; Boston Russet, 506; Hoover, 459; Glengyle Red, 458; Simmonds Winter, 457; Willie Sharp, 436; Frimley Beauty, 426; Blenheim Orange, 397; Rymer, 287; Crofton, 234; Celo, 228; Baumann's Reinette, 190; Cornish Aromatic, 177; Desert Gold, 164; Shepherd's Perfection, 117; Stansill, 101; Mobb's Royal, 87; Tasma Pride, 74; Pride of Australia, 71; Winter Strawberry, 61; Senator, 60; Scarlet Pearmain, 55; Winter Banana, 37; Kidd's Orange Red, 30; Baldwin, 27; Edward Lippiatt, 20; Giant Jeniton, 17; total cases, 1,293,330.

Pears.

Winter Nelis, 16,594; Winter Cole, 15,568; P. Barry, 7,551; Josephine de Malines, 2,942; Beurré Bosc, 2,864; Doyenne du Comice, 2,506; Keiffer, 1,602; Packham's Triumph, 1,503; Vicar of Winkfield, 1,270; Beurré Clairgeau, 1,118; L'Inconnue, 955; Glou Morceau, 693; Easter Beurré, 427; Beurré Diel, 337; Harrington's Victoria, 329; Beurré Capiaumont, 294; Duchesse d'Angoulême, 141; Winter Bartlett, 100; Broompark, 90; Madam Cole, 57; Beurré d'Amanli, 50; Chaumontel, 36; Bailey Berg, 35; Twyford's Monarch, 25; Conference, 25; Giblin's Nelis, 11: total packages, 57,123.

INTERIM RETURN OF SHEEP AT 30th APRIL, 1931.

Sheep District.	Number of Sheep.		Decrease.
	Final Returns, 1930.	Interim Returns, 1931.	
Auckland	3,325,272	3,293,333	31,939
Gisborne – Hawke's Bay ..	6,937,555	6,424,741	512,814
Wellington – West Coast ..	6,273,086	6,096,328	176,758
North Island totals ..	16,535,913	15,814,402	721,511
Marlborough–Nelson–Westland	1,526,516	1,468,830	57,686
Canterbury–Kaikoura ..	6,052,042	5,712,376	339,666
Otago	6,726,816	6,589,750	137,066
South Island totals ..	14,305,374	13,770,956	534,418
Dominion totals ..	30,841,287	29,585,358	1,255,929